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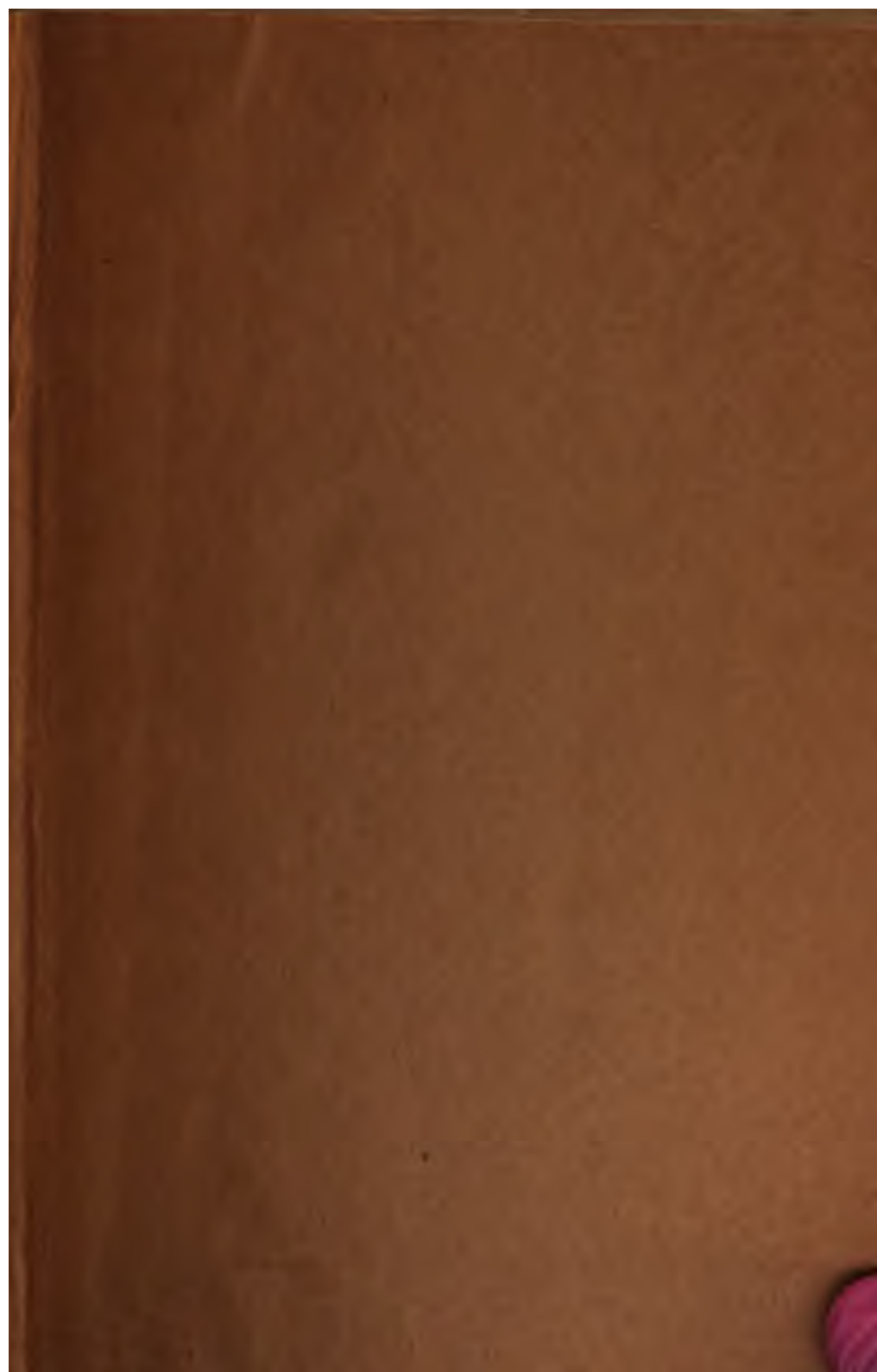
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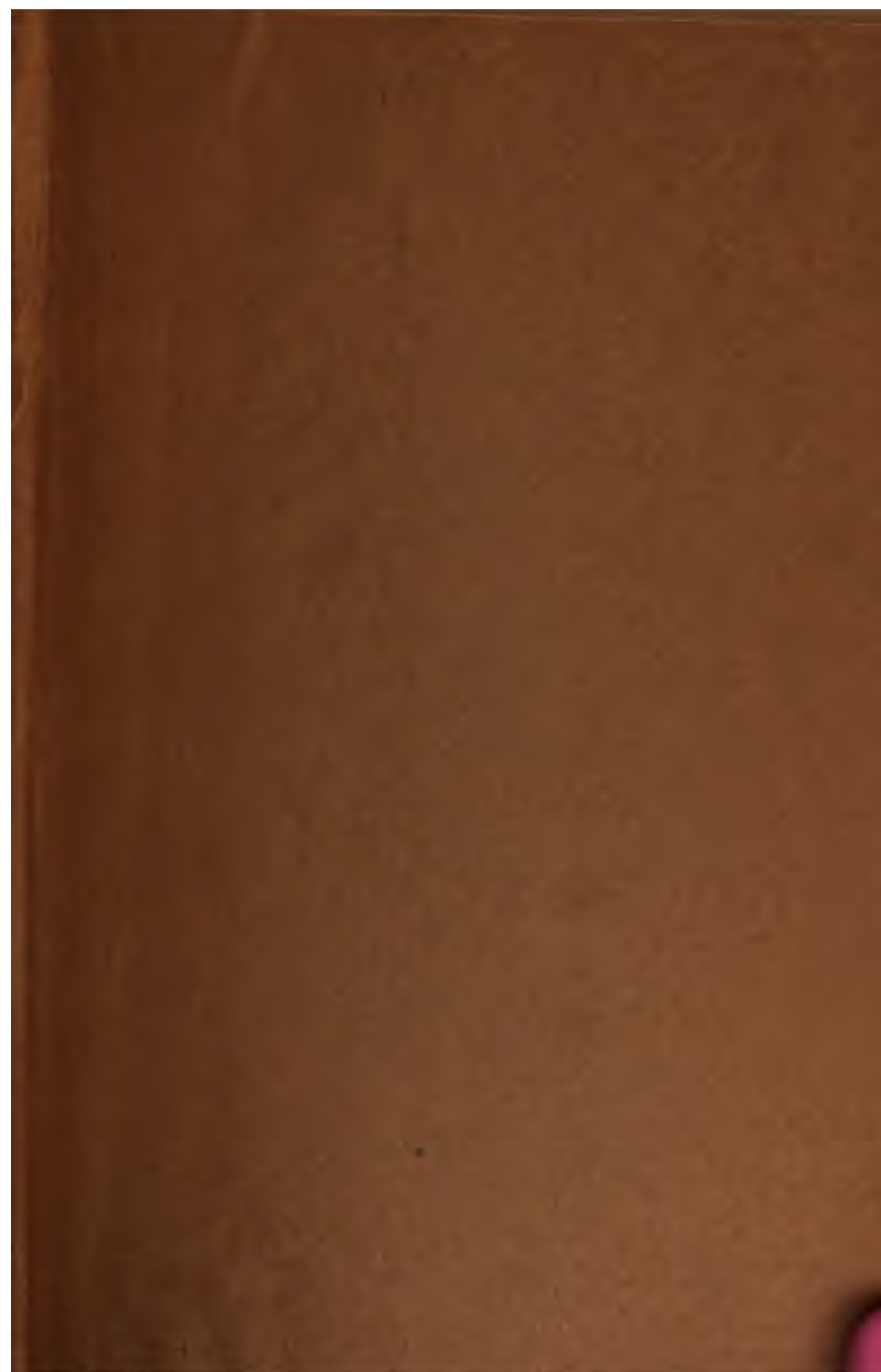


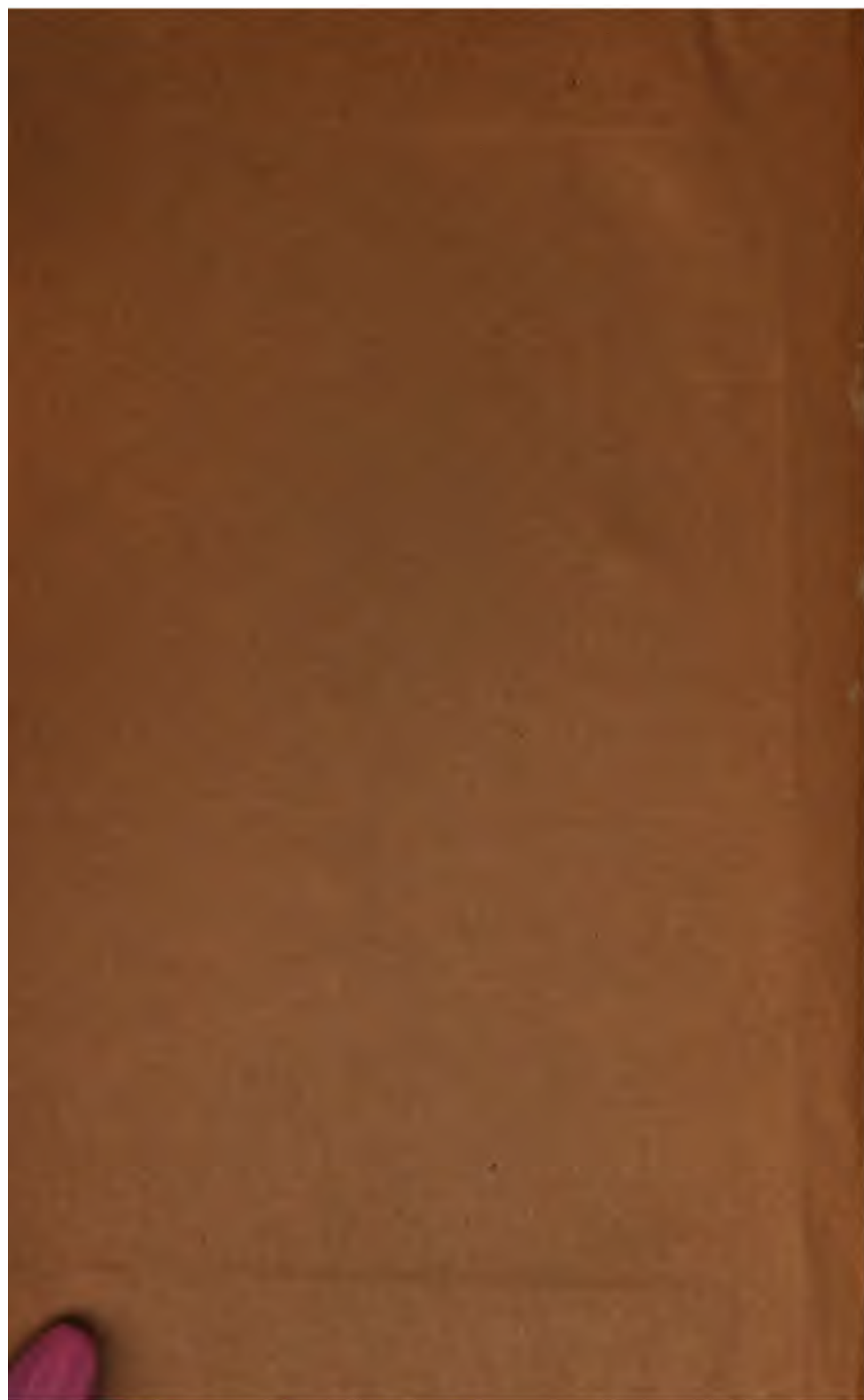




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BY
ALLEN T. BIRD



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SANTA CRUZ COUNTY, ARIZONA

THE OLDEST MINING REGION OF RECORD ON THE PACIFIC SLOPE
OF THE UNITED STATES

By Allen T. Bird

It is not known generally that the area embraced now within the limits of Santa Cruz County, Arizona, was the seat of the earliest mining known on the Pacific Slope of the United States; but such is an historic fact. Without doubt the first and earliest mining in these regions was done by the Jesuits who founded a chain of missions in the Valley of the Santa Cruz River and farther south in Mexico. According to

"La Historia del Nayarit,"

an account of the "labors of the Society of Jesus in Sempitronial America," which work was written by Fra Ortega, one of that order, and published at Barcelona, Spain, about 1754, Father Eusebio Kino, whose name has been immortalized by his great work, whose memory is embalmed in history as "the Apostle to the Pima Indians," came from the City of Mexico in 1686, and locating in 1687 a mission at a point about thirty miles south of the present international boundary between the United States and Mexico he named the mission and the river beside whose banks it stood, one the Mission Dolores, and the other Rio Dolores. From that point as a base of operations the devoted missionary established missions at Cocospera, Remedios, Santa Barbara (the latter on the Santa Cruz River, close to the international boundary, but a few miles eastward from Nogales, the county seat of Santa Cruz, right at the line).

JESUIT MISSIONS

In the Santa Cruz Valley, below the Santa Barbara Mission, Fra Kino built four other missions, the first at San Felipe Guevavi, about nine miles northeast of Nogales; another at San Cayetano del Tumagacori, about nineteen miles northwest from the same town; a third at Santiago, the site of which point is not known accurately now; and the fourth at San Xavier del Bac, nine miles south of Tucson. San Xavier has been restored by the federal government, and it is one of the show places in Arizona, thousands of interested tourists visiting it annually. It is a church of great size and beauty, its interior magnificent-

VALLEY ORNATE

ly ornamented; and it is said that the silver plate upon the altar was worth at least \$40,000.

The old church at Tumacacori (as the place is known now) is a ruin, falling fast; the Guevavi mission is a shapeless mound, while the site of the Santiago Mission is unknown.

Father Kino extended his explorations beyond the Gila River, and established a chain of missions in the Valley of the San Pedro River, but for the purposes of this bulletin nothing further need be written of them.

In the vicinity of each mission was a *presidio*, or military post, with a garrison sufficiently strong for protection of the surrounding region from the marauding Apaches, who occupied regions beyond the San Pedro and the Gila, whence they were wont to make excursions of rapine and ravage into the country of the Pimas and the Papagoes, peaceable Indians occupying these regions, who readily embraced Christianity, coming easily under the domination of the gentle priests. Those Indians were tillers of the soil and laborers. From among them were drawn the workers in the mines and on the ranches that the friars and laymen among the Spaniards discovered and exploited. Tubac, on the Santa Cruz, twenty-two miles from Nogales, was the *presidio* near Tumacacori, and recently there have been unearthed there a lot of old, rusty twelve-pound cannon balls that were no doubt for use in some of the artillery of the garrison. Tucson, which had been the site of an Indian village, was the *presidio* for protection of the country surrounding.

According to the history of that time, and the records of the mission, now preserved in Spain, the friars at Tumacacori discovered and wrought

RICH SILVER MINES

in the Santa Rita Mountains, to the northeast, and in the Atascosa Mountains, on the southwest. The Salero mines and other properties in the Santa Ritas are known to have been operated by the friars, and in places vestiges of their workings are found yet today. In recent years a party from California having a plat or map with a written description of the location, said to have come from the archives of the old mission, has been searching in the Atascosa Mountains for an abandoned mine that the record they have tells of having been exploited by the friars. Those operations are established to have been inaugurated very shortly after completion of the Mission church and cloister at Tumacacori in 1688. So there is presented the record of the

FIRST MINING

done on the Pacific Slope of the United States. . . .
But the Jesuit priests and missionaries were not the only miners

among the successors of the conquistadores. In all parts of its American possessions the Spanish crown encouraged mining, offering every facility and giving military protection. Here, as elsewhere, hundreds of adventurous Spaniards prospected the hills and mountains, exploiting valuable mines paying readily to the treasury of the sovereign one-fifth and to the coffers of the church another fifth of their gross product. As their labor was very cheap, giving the Indians a bare subsistence, with which the latter were content, and their processes were crude and primitive, yet inexpensive, those heavy exactions were not really burdensome. Modern mining with high-priced labor and expensive machinery could not stand a tax of 40 per cent upon production.

Some historians have endeavored to minimize the labors of the Spanish during their occupation of this part of North America, and affect to have found no record of extensive cultivation of the lands, exploitation of the mines, or abundant population in those decades. But the record is against them. Ortega, in the "*Historia de Nayarit*," recounts the baptism of thousands of Indians at various missions, and there are extant in the Spanish and Mexican archives many maps and accounts of the settlements on the Santa Cruz and San Pedro. In an address before the American Geographical and Statistical Society, in New York, in 1859, Sylvester Mowry, whose name is linked inseparably with the early history of American occupation, stated that he had in his possession a copy of an early Spanish map of the country, and that within the area comprised by the Gadsden Purchase, embracing the region south of the Gila River to the present international boundary, there were no less than

FORTY TOWNS AND VILLAGES,

many of them of considerable size. The original map, with accompanying notes, was made in 1757, sixty-nine years after the advent of Father Kino, and in his address Lieutenant Mowry stated that at that time it was in the archives of the Mexican government at their federal capital, his copy having been made from the original by Captain C. P. Stone, U. S. A. To quote Mowry:

"The Santa Cruz and its tributary valleys teemed with an agricultural and mining population. . . . The notes referred to contain the names of more than one hundred gold and silver mines worked by the Spaniards. The survey by the Jesuit priest (Father Kino) about 1687 was repeated in 1710 with renewed accessions of population. From that time to 1757 conquest and settlement of the country were prosecuted with vigor by both the Jesuits' Society and the Spanish government."

Under Spanish domination the region described continued to pros-

per until the Mexican Revolution of 1810-20. For service against that finally successful revolt the Spanish government withdrew to the interior the troops that were the protection of Pimeria Alta, as the region was named, and they were not replaced by the revolutionary government which arose in succession. Then, in 1820, there came the

GREAT APACHE UPRISING

And the entire region with half of Sonora were devastated and harried with little cessation for more than a half century. Settlements were destroyed, mines abandoned, missions deserted, and the population nearly wiped out from existence. All the settlements within what became the Gadsden purchase, except Tucson and Tumacacori, disappeared, and in Sonora cities that numbered their population by thousands became mere villages. Arispe, one time the capital of all the Pacific Slope possessions of the Spanish crown, which had a population exceeding thirty thousand souls, fell in numbers to less than ten per cent of that enumeration.

With acquisition under the Gadsden Treaty in 1856, and occupation of the country by American troops, there came again the military protection necessary for peace and uninterrupted operation. With that assured attention was turned in this direction by American mining men, and several enterprises were inaugurated, meeting with more or less success.

That peaceful condition, however, continued but a few short years. At the outbreak of the Civil War, in 1861, the troops were withdrawn, the country was given over again to the Apache, mines, camps and settlements were attacked, their owners and help were murdered, and those who escaped destruction departed the country.

As soon as possible the Washington government restored military protection, and with the close of the Civil War, in 1865, attention was turned to making the country safe. A reservation was provided and the

APACHES WERE DRIVEN

upon it by force of arms. But occasionally a predatory band made a marauding excursion from the reservation, ravaging the country and seeking safety in the fastnesses of the Sierra Madre, in Mexico.

In 1880 the largest and most dangerous of the marauding bands was followed into Mexico and captured by American soldiers led by Captain Lawton. They were deported to Florida (as far away from the scenes of their devilment as was possible), and none of them were ever permitted to return to Arizona.

That effective policy brought the long desired peace, and there began for Arizona a new era of development and prosperity which continues yet without abatement.

In the operations following

AMERICAN ACQUISITION

in 1856, Tubac, on the Santa Cruz River, without doubt one of the oldest settlements in North America, assumed renewed importance and became quite a center of population. A number of companies operating mines in the mountains on either side made the place their headquarters.

Among those operating at that time was Charles D. Poston, who became afterward the first Delegate in Congress, after Arizona was created a Territory, in 1864 (cut off from New Mexico), who was managing a property in the Atascosa Mountains, now known as the Cerro Colorado Mine, which is in Pima County.

The Salaro Mines, worked in 1688 by the friars at the Tumacacori Mission, were taken up by a Cincinnati corporation, at its head John W. Wrightson, who had been business manager of the Cincinnati Enquirer. In 1861 Wrightson was killed by Apaches, as were Grosvenor and Hopkins, his superintendent and geologist, respectively, and operations were abandoned. The properties are in the Santa Rita Mountains, and have been worked until of late years. They are valuable yet, but the owners have died, and their estates have given no attention.

Contemporaneous with Poston and Wrightson was Sylvester W. Mowry, an army officer, who took up a group of mines in the Patagonia Mountains and established the Mowry Mining Camp. Lieutenant Mowry erected a reduction plant and produced a great deal of lead-silver bullion, which he transported by wagon to Guaymas, the seaport of the adjacent State of Sonora, in Mexico, and shipped by water to Swansea, Wales. During the Civil War Mowry was accused of treason to the United States and his property was confiscated. In later years the property passed to others, and it has been worked with good returns. It has been idle now a number of years, the later owners having become involved in litigation.

The mines at Duquesne and Washington Camp were worked also at about the same time as the Mowry, preceding the Civil War; and it is believed that some of the ledges in that vicinity were exploited by Mexicans previous to the time of the Gadsden Purchase.

Upon the west side of the Atascosa Mountains, in the extreme end of the county, adjacent to the Mexican border, lies the Oro Blanco region. Tradition has it that good gold placers were worked there in *antigua* days, but there is nothing authentic.

In the Greaterville region, on the northeast slope of the Santa Rita Mountains, there are also gold placers and quartz ledges bearing gold,

but mostly that mineral country lies across the line in Pima County.

GEOGRAPHY

Santa Cruz County is that political subdivision of the State of Arizona which abuts upon the international boundary about the center of the southern tier of counties. Its greatest length, east and west, is about fifty miles, and its greatest width is about thirty. Its chief drainage channel is the Santa Cruz River, rising in the San Rafael Valley, between the Patagonia and Huachuca Mountains, in the southwestern section. That river flows southward some miles into Mexico, makes a great bend around the base of the San Antonio Mountains, entering Arizona about five miles east of Nogales, continuing across the county in a northwesterly direction, skirting the western bases of the Patagonia, San Cayetano and Santa Rita Mountains with the Atascosa Mountains lying to the westward. The Santa Cruz River Valley is from two to four miles in width.

The chief confluent is the Sonoita River, Nogales Wash and Sopori Creek. The first named rises in the region eastward from the Santa Rita Mountains, in the summit of a low ridge connecting the Huachuca Mountains and the Santa Ritas, flowing in a general southwesterly direction, cutting through the depression between the Patagonia and Santa Rita Mountains, skirting the southern base of San Cayetano Mountain and joining the Santa Cruz near Calabasas, about nine miles north from the Mexican line.

Sopori Creek is in the northwest part of the county, flowing due east near the line between Santa Cruz and Pima Counties. The Oro Blanco region drains into the Altar River Valley of Sonoita. In the northeastern part of the county the Rain Valley drains eastward into the San Pedro River through Babacomari Creek, and northward to the Pantano Wash through Cienega Creek.

RAILWAY SYSTEM

consists of two branches of the Southern Pacific, the Benson-Nogales line, eighty-eight miles in length, entering the county near Elgin, about the northeast corner, crossing Rain Valley, passing between the Santa Rita and Patagonia Mountains, following the course of Sonoita River to Calabasas, where it crosses the Santa Cruz River, thence up Nogales Wash to the town of the same name; and the Tucson-Nogales line, fifty-eight miles long, to Calabasas, from which point both lines use the same track jointly.

A good system of wagon roads throughout the county is in course of construction, a road bond issue of \$150,000 having been voted by the people in 1915, and the bonds sold at a premium. The

MOUNTAIN SYSTEM

embraces the Patagonia, Santa Rita and Atascosa Mountains, with the Canelo Hills and Grosvenor Hills. The Canelo Hills are a spur from the Huachuca Mountains, in the western foothills of which runs the east line of the county, and they separate the Rain and San Rafael Valleys. They connect the Huachucas with the Santa Ritas. The Grosvenor Hills are in an offshoot from the Santa Ritas extending toward the San Cayetano Mountains. The Patagonia and Santa Rita Mountains are practically a continuous chin, cut by the Sonoita Canyon, extending clear across the county in a northwesterly direction, and extending into Pima County nearly twenty miles. The Atascosa Mountains cross the county in a northwesterly direction westward from the Santa Cruz River. The mountains vary in height from 5,000 to 9,000 feet, Old Baldy, the highest peak in the Santa Ritas, reaching an altitude of 9,432 feet. The valleys are elevated, the lowest point being at Amado, near the Pima County line, which is about 3,000 feet above sea level. The

MINING DISTRICTS

are the Nogales and Patagonia Districts, abutting upon the international boundary, the latter covering the south end of the Patagonia Mountains; Palmetto District, on the west slope of those mountains, extending to the Rio Sonoita; Harshaw District, embracing the north end of the Patagonias; Red Rock District, extending from the Harshaw northeasterly to the Canelo Hills; Wrightson District, on the east side of the Santa Rita Mountains, extending to the Sonoita River, which flows there in a southerly direction; Tyndall District, on the west side of the same mountains, extending from the Sonoita northward into Pima County, including the Grosvenor Hills in its southern area; parts of Old Baldy and Greaterville Districts, which are in Pima County; San Cayetano District, covering the mountains of the same name; Pajarito District, at the south end of the Atascosa Mountains, Soporí District at the north end, and Oro Blanco District, on the western slope of the same range.

GEOLOGY

Within the area of the county there are presented in great variety both igneous and sedimentary rocks. In age they are said by geologists to range from pre-Cambrian to Recent, igneous rocks predominant areally. The sedimentary rocks have been folded extensively, upturned, faulted, fissured, metamorphosed, intruded by igneous masses and dykes of granular rocks, becoming important ore-bearing foundations. The most abundant of the intrusive rocks are granite, quartz monzonite, granite porphyry and rhyolite, although there are found

many more varieties, such as aplite, quartz latite, syenite, etc. These intrusive rocks occur in the mining districts, and with many of them are associated fissure vein that seem related with them in origin. Such fissure veins are numerous and widely distributed, being particularly plentiful along the west slope of the Santa Rita Mountains and in the Patagonia Mountains. They range from one to twenty feet in width, averaging about six feet. The

FISSURE VEINS

Cited, and metamorphic-contact or replacement deposits are the magma or gangue containing gold, silver, lead, copper, zinc, tungsten, molybdenum and other metals that are the cause and foundation of a mining industry which within this area has produced a great deal of wealth, and is destined to make Santa Cruz County one of the most important metal producing regions in Arizona.

To a great extent early development of the vein system presented a production of lead and silver, with slight percentages and traces of copper, which increased gradually as depth was attained; and in nearly all the mineral ledges or deposits in which development has reached any depth they have become

DISTINCTIVELY COPPER BEARING

In fact, microscopic examination of lead-silver ores from the surface deposits has demonstrated that originally they carried much more copper, and that they have been altered by percolation of surface waters seeking the depths dissolving and carrying the copper with them to the water level (metasomatism). The lead-silver mines at Duquesne, Washington Camp, Mowry, World's Fair, etc., in the Patagonia Mountains; and at Alto, Mansfield and other camps in the Santa Ritas, all give evidence of the metasomatic action noted. Where the veins and ledges predominate in copper from their very croppings it is plain that the metasomatism noted elsewhere has not occurred. Even in gold bearing sections, such as Oro Blanco, there are presented instances of metasomatic action—notably the Austerlitz Mine, which has produced gold and silver abundantly, but in the deeper workings has commenced producing copper.

In recent years there has been presented in the Patagonia Mountains a gratifying development of

COPPER BEARING PORPHYRY

Great masses of porphyritic rocks carrying finely comminuted particles of copper (chalcocite and chalcopyrite) disseminated evenly through the magma, giving low per centages of the metal, yet wrought easily and profitably when handled upon a great scale, as at Bingham, Utah, and Ray, Arizona, dependable for production of vast quantities of

the red metal, returning large dividends upon a heavy capitalization.

One of the great copper deposits mentioned is the noted "Red Hill," at the north end of the Patagonia Mountains, overlooking the town of Patagonia; the other is about a dozen miles south, upon the axis of the same range, not far from Duquesne and Mowry, but upon the west side of the summit. The first is a great mass—a mountain—of low-grade rhyolitic porphyry, carrying 1 per cent to 3 per cent copper, a proposition for working with steam shovels, railway trains, great concentrating mills and colossal smelting furnaces. The other, under development by the Red Mountain Copper Company, is overlaid by a thick shell of non-mineral rock of the same general texture and quality, which prevents the steam shovel, but the ore body may be handled by the

CAVING PROCESS

Eventually both of these "Red Hills" will become foundations of great copper producing industries.

Many of the ores produced from the veins, ledges and deposits of Santa Cruz County have proved rebellious and difficult for recovery of all the metaliferous values therein. Notably this has been true of ores carrying zinc along with the lead and copper. Where the zinc content was high and it went into the tailings the loss in values was the profit that was necessary if operation was to continue. In some instances the zinc lost in that way ran as high as 20 per cent of the weight of the rock. That problem seems to have been solved by the recently discovered and perfected process of concentration by

OIL FLOTATION,

as one such plant is in successful operation by the Duquesne Mining & Reduction Company, at Duquesne, about three miles north from the Mexican border in the Patagonia Mountains. The ores from other localities have been tested by this process, with results highly gratifying, and its adoption in all parts of the county is but a matter of a short time. So successful has been the process at Duquesne that the capacity of the plant is to be doubled at once.

This same company is inaugurating a new departure in the substitution of steam by electricity for driving its machinery, the "juice" to drive the motors being supplied from a central electric plant at Nogales, and conveyed by an electrical

TRANSMISSION LINE

a distance of nearly twenty miles. For driving their machinery several smaller properties on the line are arranging to purchase power; and the plans of the International Gas Company, operating the electric power plant at Nogales, contemplate ramifying their transmission lines to all

parts of the county and delivery of power wherever desired. The present plant, completed in November, 1915, consists of two great Diesel type internal combustion oil burning engines, each driving a colossal alternating current dynamo, each unit capable of developing 550 horsepower. As the transmission lines are ramified among the various camps other similar units will be installed. The advantage of this cheap and readily available power will be a great factor in mine operation and ore reduction, while the impetus it will give the industry in Santa Cruz County can hardly be measured in contemplation or anticipation. Instead of installing ponderous engines to drive mills, hoists, etc., and boilers to generate steam for power, maintaining heavy investments in machinery, fuel, labor cost, etc., a company can drive all its machinery at small cost with a few inexpensive motors and a short wire connecting with the main transmission line. The

NOGALES MINING DISTRICT

includes the region north of the international line and east from the Nogales Wash, to Calabasas and the Sonoita River on the north, the eastern boundary being a line extending in that direction from a point where the Santa Cruz River emerges from Mexico. It is about ten miles long and seven in width. It is an elevated region, a spur extending northward from the high divide between the Gila River basin and the coast of the Gulf of California. The highest point is Mount Benedict, some three miles north from Nogales, rising to an altitude of 4,500 feet; but the greater part of the area has an elevation less than 4,000 feet above sea level.

The mineralized area in the district is upon the slopes of Mount Benedict, and chiefly they are gold bearing, although silver, lead and tungsten have been found. The formation is quartz monzonite with intrusions of diorite, aplite, granite-porphyry, etc., with which most of the mineral deposits are associated. Near the Santa Cruz River there are placer beds from which some gold has been recovered.

In the workings near the surface of some of the ledges the ore is said to have been very rich, but it was in small quantities. One shipment from the Dura Mine, sent to the Selby smelter, in California, is said to have yielded thirty-five ounces gold per ton; three carloads shipped in 1903 averaged \$600 gold to the car. In 1895 a prospector named Lichliter shipped eighty tons which averaged \$50 gold per ton.

At a little depth the veins seem to pinch out, but the geological indications are that if followed down they will widen again, and become productive once more. So far as competent observers have given attention the ore occurrences are in lenticular form, and the surface open-

ings were the lower sections of a series of lenses that had been cut down with erosion of the surrounding region.

The principal properties are the Dura, Uncle Sam, Lion, Columbia, Float Gold and Reagan Mines. Near Guevavi, the site of one of the old Jesuit Missions, described hereinbefore, the Float Gold Amalgamating Company has a small stamp mill that was operated with considerable success in 1913. In the Reagan property there has been developed wolfram and scheelite (a shipment of which ores yielded about 50 per cent tungsten acid. The

PATAGONIA DISTRICT

is adjacent to the Nogales District on the east, and crosses the southern part of the Patagonia Mountains. The east and west width is about twelve miles and it extends northward from the Mexican border about eight miles. In elevation the mountains average about 5,500 feet, and the highest peaks reach 7,000 feet. They are precipitous, rugged and sparsely timbered with scrub oaks and juniper trees. As classified by geologists, the rock formations include Mesozoic limestone, quartzite, shale, etc., with intrusions of quartz monzonite (classified generally as syenite or granite), granite porphyry, diorite, etc., sedimentary Mesozoic rocks consisting of shales and arenaceous limestones; Tertiary rhyolite; and gravels and wash. As a rule mineralization occurs in or is associated with the intrusive rocks; but at Duquesne and Washington Camp they are a result chiefly of contact-metamorphic action.

The mineral deposits occur in a broad belt about six miles in width extending across the district in a northwesterly direction, following the trend of the mountain chain.

The district includes about forty promising groups of mines and mining camps, while the number of good claims and prospects runs up into the hundreds. Some of them are good producers now, and many have great records of production in former years. Among them may be mentioned the mines at Duquesne and Washington Camp, the Four Metals properties of the Red Mountain Copper Company, the Mowry Mines, Gross Group, Morning Glory, Old Soldier, Good View Mines (formerly Buena Vista), Santo Nino, Proto Group, Gladstone Mines, National Havelena, Creston, Skibo Development Company's properties, Golden Rose, Providencia, and many more. The

GREATEST DEVELOPMENT

is presented at the Washington-Duquesne Camp, where the Duquesne Mining & Reduction Company, of Pittsburg, Pennsylvania, is operating upon an extensive scale, and has penetrated to the greatest depth of any work in the district, with the greatest record of production. The camp lies about three miles from the international line, sixteen

miles from Nogales, and twenty miles south from Patagonia, on the east side of the main range of the Patagonia Mountains, the mines at altitudes varying from 5,000 to 6,000 feet.

Although less than a mile apart, Duquesne and Washington Camp were separate entities, the mines under various ownerships; but acquisition gradually of all the properties by one company has united the two into a single camp. The reduction plant is at Washington, and while the mines are all around both places the most important development and deepest workings are at Duquesne, an aerial tramway connecting the shaft with the mill.

Some of the claims were exploited before American acquisition, ruins of adobe smelters in the vicinity being witness to the fact; and others were known as producers more than forty years ago. In those days lead and silver were sought, and the ores extracted from near the surface were very rich in both metals. With depth and replacement by basic ores (sulphides carrying zinc and copper), profits disappeared and operations were suspended.

In the last decade of the Nineteenth Century the copper possibilities attracted attention, and the Westinghouse interest, as the enterprise is known, began acquisition of properties and development of ore deposits, gradually extending its holdings until there are embraced now under one ownership more than 1600 acres of good mining ground, embracing eighty claims, of which about forty are patented.

The main shaft, on the Bonanza property at Duquesne, is three-compartment, 635 feet deep, with extensive underground workings, exposing large and valuable ore bodies, from which there has been extracted many thousand tons of high-grade ores that paid to ship.

Acquisition of the Pride of the West properties and reduction plant at Washington Camp, in 1906, gave the Duquesne Company another highly developed property, with large facilities for treatment of ores. The Holland and the Belmont Mines, which were taken over about the same time, and the Empire, which came later, all gave the enterprise well developed claims, with large ore bodies demonstrated. Other properties not mentioned here added greatly to the known ore reserves.

THE PROBLEM

all along has been to find and apply a process that would reduce the ores economically and save all the values. Toward that end thousands of dollars have been expended in experimentation. As stated in another place, oil flotation has solved the problem, and the enterprise is about to enter upon a long period of unremitting profitable production.

The machinery equipment consists entirely of the best types of mechanical appliances, while plans adopted contemplate great and exten-

sive additions. In the course of a few years the industry will attain great growth and become highly productive.

The formation is one of great interest, the country rock being a great belt of limestone and quartzite surrounded by igneous upthrusts, the ore deposits occurring in the metamorphic contact rocks. They carry lead, zinc, copper, silver and some gold.

In the vicinity are the Brooks-Fassig group of mines, the Line Boy group, the property of the Armada Copper Company, and the Santo Nino group, the latter the property of the Havalena Mining Company, in which there has been made a wonderful development of molybdenum ores. The

MOWRY MINES

are located on the east side of the Patagonia Mountains, about four miles north from Washington Camp. They are distinctively lead and silver producers, and have been worked to a depth of 500 feet. There are about 12,000 feet of underground workings, and a large and effective machinery equipment consisting of a smelting furnace, hoists, etc. Unfortunately a concentrating mill that was a part of the plant was destroyed by fire several years ago. Litigation and internal difficulties in the Santa Cruz Mines, Smelter & Transportation Company, which owned and operated the mines (also the Alto Mines in the Santa Rita Mountains) have caused suspension of operations through several years.

Tradition says that the Mowry was worked by the Jesuits during *antigua* times, but there is no record of the operation. The authentic account of early operation antedates the Civil War by two years, when Lieutenant Sylvester Mowry, U. S. A., commenced operation of the property and continued working about four years, erecting a reduction plant and shipping lead-silver bullion and high-grade ores to the value of about \$1,500,000. This has been mentioned on a preceding page.

The formation is a fault contact between limestone and quartz monzonite, and the ore bodies are to a great extent replacement in the limestone. The ores are highly argentiferous lead combinations, and they have run high in values.

In the vicinity of Mowry are the Skibo, Cunningham, Endless Chain, Bullwhacker, Olive and other good properties. The Olive was a shipper of high-grade ores in the early '70's. The

FOUR METALS MINES

about three miles southwest of Mowry, on the west side of the main crest of the Patagonia Mountains, is one of the properties mentioned earlier in this account as a remarkable presentation of a large, low-

grade copper deposit, that will pay handsomely if worked on an extensive scale, with a great reduction plant, automatic in operation, handling ore in masses. It has been explored by a series of tunnels, three in number, with their various drifts, crosscuts, winzes, etc., aggregating more than a mile of work, proving to a depth of 600 feet below the croppings an extensive ore body that has been penetrated several hundred feet in all directions without reaching the utmost limits. There is in the gulch below a fourth tunnel site which will be developed shortly, giving a couple hundred feet more of "backs." Below that development will have to be by winzes, and there is no doubt that with the water level reached the character of the ores will change to copper sulphides, and very likely it will be found higher in grade. In fact, present development shows more copper in the ore in the lowest tunnel than in that in either of the others, and between those two the same rule prevails. The copper bearing rock is a rhyolitic porphyry, ground and crushed, with highly comminuted particles of chalcocite, chalcopyrite and pyrite disseminated throughout the mass. It is very friable, easily pulverized and concentrated, the concentrates going about one ton from sixteen tons of ore. As the rock in the lowest tunnel goes about 3 per cent copper, it shows that concentration will give a high-grade product. The Red Mountain Copper Company, owning and operating the property, is working conservatively, exploring the ore body and demonstrating daily its greater size and capacity for production, until such time as the need for a great reduction plant is proved, when one will be provided. The

BUENA VISTA MINES,

owned and operated by the Good View Mining Company, lie a couple of miles west from the Four Metals property, and they have entered recently the list of producers, a small concentrating plant having been installed to reduce the ores to concentrates. The mine is opened by tunnels, on a ledge about four feet in width with a pay streak of high-grade chalcopyrite eighteen to twenty-four inches in width, that is very rich in copper. A deal of the ore has been shipped, with good results. The concentrator will effect a saving in transportation.

In this same vicinity are the Providencia, G. L. & C. group, Shannon group, Proto Mines, Gladstone, Old Soldier, Creston, National and many more good claims and promising prospects. Capital and development are all that are needed to place them in the list of permanent and profitable producers. Upon the east side of the Patagonia Mountains the

HARSHAW DISTRICT

joins on the north that part of the Patagonia District which extends

across the range. The district extends northward to the Sonoita River, at Patagonia, its western boundary following closely the crest of the mountains, the formation of the two districts presenting the same general characteristics. It includes some of the most noted and notable mines in Southern Arizona, including the Hardshell, Hermosa, World's Fair, Trench, Wieland Group, Blue Nose, Jefferson, Sunnyside, Buffalo Group, Chief Group, Great Silver Mine, and many more. At the present time active operations are conducted in a number of those named.

The Hermosa Mine was operated in the early '80's by a New York Company which built a 20-stamp mill, that produced a deal of silver bullion. At that time the record of production was more than a million dollars within eighteen months, and later it produced another half million. It is believed to contain yet a great deal of valuable mineral, well worth exploitation.

The Hardshell, which is adjacent to the Hermosa, has also a great record of production. Upon the property there is a concentrating mill. After a period of idleness extending over a number of years, the property has been taken over recently by experienced mining men, who will renew the history of the mine. Probably the

WORLD'S FAIR MINE

is one of the most noted and valuable properties in the district, with a long record of production. The property lies about two miles west from Harshaw. The location was made in 1879, and at that time considerable high-grade ore was shipped.

In 1884 the property passed by purchase to Frank and Josephine Powers, the consideration said to have been \$100. It is reported that within a few months the purchasers had extracted and shipped several 25-ton carloads of rich rock that yielded from \$8,000 to \$25,000 per carload. Shipments were made, however, only when money was needed, and from ores taken out in development. In 1903 it was estimated that such development had exposed, ready for stoping and shipment \$600,000 worth of high-grade lead-silver ores. The owners have been content to let the values remain in the ground, as a safer place than bank vaults; and the property has never been exploited to swell a plethoric bank account; yet, according to statistical information, in 1907 the production was \$74,210 in ores yielding lead, copper, gold and silver. During 1910 the production was \$42,730.82. There has been production every year, and since its discovery in 1879 the World's Fair is said to have produced more than one million dollars. It is in operation yet, and daily there are extracted many tons of high-grade ores, rich in lead, silver, gold and copper.

The World's Fair is developed to a depth of 600 feet, and it is the deepest mine in the district. The underground workings measure about 15,000 feet of tunnels, drifts, shafts, stopes and winzes. The main entrance is a crosscut tunnel at an altitude of 4,680 feet. In this tunnel is a winze 600 feet deep, with 1,000 feet of drifting each way, the development following the vein, with levels 100 feet apart.

There is a good equipment of machinery, including a 10-stamp mill. However, there has been little use for that, the rich ores bearing shipment to points where cost of reduction is much lower.

The country rock is diorite intruded with rhyolite, and the ore deposits seem associated with the lines of contact between the two kinds of rock. The average width of the vein is about six feet, and it is filled with high-grade rock.

In the upper workings the ores were generally lead-silver; but below the water level the usual law of the region prevails, copper coming into the combination with some antimonial silver and high values in gold. The average values are said to run 20 per cent copper, 500 ounces silver, and \$15 per ton in gold.

There have been made a number of offers to purchase, and there have been some negotiations, but without result. The sales price set by the owners is one million dollars, 10 per cent in hand without inspection of the property.

North from the World's Fair Camp, about a mile, there lies the other "Red Hill," or

PORPHYRY-COPPER DEPOSIT

mentioned elsewhere, that promises the foundation for a great producer of the red metal. Beside the great mass of porphyritic rhyolite in the mountain, there are many mineralized veins and dykes, from some of which good shipping ores are taken. In the Aztec Group, on the north side of the hill, not far south from Patagonia, there occurs such a vein; and on the east side of the hill there are others, in the Hardtmayer claims and in the properties of Wagner & Fessler.

Northeast from the World's Fair, about a mile, is The Basin, a region that holds in a great hollow a cluster of good mines, including the Wieland Group, Buffalo Group, Red Men, Great Silver Mine, and several others, in various stages of development, some of them shipping ores at the present time. The

PALMETTO DISTRICT

lies on the west side of the Patagonia Mountains, between the Harshaw and Nogales Districts, extending northward from the Patagonia District to the Sonoita River. From east to west its width is about four miles, and the length is six. The topography is rough, and on the

east side of the district the contour rises abruptly from an altitude of about 4,500 feet to one exceeding 6,000 feet, the summit of the highest being about 6,400 feet above sea level.

The country rocks embrace diorite, quartz monzonite, rhyolite and granite-porphyry, the second in the list predominating. The mineral deposits lie in the eastern part of the district, and they are associated closely with those found in the Harshaw District adjacent on the east, many of the properties in the two districts being in juxtaposition, notably the World's Fair and Chief in the Harshaw District, and the Flux and R. R. R. in the Palermo District.

The ores comprise lead, silver and copper. The lead-silver ores occur in the quartz monzonite, and the copper is found in the granite-porphyry and sedimentary rocks. In some cases the lead-silver ores carry a little gold, silver and molybdenum.

The principal mines in the district are the Flux, Domino, R. R. R., Jarilla, New Hope, Palmetto, Sonoita, Arizona-European, Grey Brothers, Dos Amigos, and others. The most noted and most important, in point of development, are the

R. R. R. MINES

which attracted great attention some three years ago on account of magnitude, richness and great value of the copper deposits encountered; and the development thereof gave to mining in the surrounding region an impetus which marked a new era in the affairs of Santa Cruz County, but which was checked by a protracted litigation between the original owners of the property, litigation that is still in the appellate court, and has caused a suspension of operations with cancellation of a bond and lease under which the property was in operation.

In the holdings of the R. R. R. Group there are included fifty or more good claims. They lie on the west side of the main range of the Patagonia Mountains, about four miles south from the town of Patagonia, just below the crest of the ridge, at altitudes ranging from 5,500 to 4,000 feet.

The ground rises abruptly, giving excellent opportunity for development by tunnels, which is the system employed, there being four, from 200 to 600 feet in length, with a shaft 375 feet deep. The entire development embraces several thousand feet of tunnels, shaft, cross-cuts, winzes, etc., and as developed the ore body gives 700 feet of backs. A wagon road from the entrance of the lowest tunnel to the railway station at Bloxton, $3\frac{1}{2}$ miles away, which is the shipping point, gives excellent facility for hauling the ore to a railway.

Between May, 1911, and October, 1914, ore shipments are said to have reached a total exceeding one million of dollars in value, the

shipments continuing at the rate of 100 tons of good ore daily. The rock is said to have averaged 9 per cent copper. The ores are chalcocite, chalcopyrite and pyrite, with occurrences of galena and cerussite.

The country rock is mainly a granite-porphry, and the ore deposits occur in a shear zone traversing those rocks.

At this writing the litigation pending in the Supreme Court of Arizona has been argued, a decision is due at any time, and when it is given it is to be hoped that the litigious owners will be able to make a composition by which operations can be resumed.

In the immediate vicinity of the R. R. the Flux Mine is in operation, a concentrating mill reducing the ores, and the concentrates are shipped. The mine and mill are connected by an aerial tramway. The property, owned and operated by the Sterling Development Company, has a record of production antedating the Civil War.

The Jarillas Mine, near the south end of the district, the property of Messrs. E. E. Bethell, of Patagonia; Bracey Curtis and Doctor A. L. Gustetter, of Nogales, is in active operation and presents considerable development. The ore is high grade, carrying lead, silver and gold. Shipments made some years ago yielded \$5,000, giving returns of 40 per cent lead, 175 ounces silver and 1 ounce gold per ton.

Of course, it is understood that the properties mentioned in these descriptions of the various districts are but a few of those worth giving attention. To give a very short description of all would extend this bulletin to a large volume. The

RED ROCK DISTRICT

lies adjacent to the Harshaw District on the northeast, and eastward from the Sonoita River, extending to the summits of the Canelo Hills. The mineral bearing areas are limited, and the formations are not conducive to mineral occurrence. The principal properties are La Plata, New York, Meadow Valley, Copper Mountain and Sheehy Group. Ores have been shipped from the New York, La Plata and Meadow Valley properties. In the Sheehy Group there has been done considerable work upon a low-grade copper proposition of large extent, which, with development, may prove important. There are numerous small prospects showing very little work. The

WRIGHTSON DISTRICT

Covers the east and southeast slopes of the Santa Rita Mountains, the southern and eastern boundaries of the district being defined by the Rio Sonoita. The north line intersects Old Baldy, a turn of that line in a southeastern direction joins the east line at the river, a prolongation thereof crossing the stream, continuing as the northeast line of the Red Rock District. The greatest length of the district, from Old

Baldy to the Sonoita, near Patagonia, is twelve miles; the greatest width is eight miles on an east and west line.

The topography is rough and altitudes vary from 3,500 to 6,500 feet, rising to 8,000 and 9,000 on the great summits in the north, with heavy erosion, deep canyons and lofty ridges. Generally the mining claims follow the ridges, opened by tunnels from the gulches and canyons, although that rule of development is not universal. Chiefly the formation is andesite, a belt of the rocks $2\frac{1}{2}$ miles wide extending north and south across the west central portion, flanked on the northwest in great part by the underlying rhyolite, and partly by a narrow bowl of quartz diorite and monzonite. On the south the country rock is granite porphyry. The eastern part is covered with quaternary gravels with intrusions of older rocks.

The ore deposits carry lead and silver principally, with some copper, there appearing the same tendency manifested elsewhere to increase in copper as depth is attained. They occur in quartz bearing fissure veins or consist of replacements in the igneous and metamorphic rocks. In the Temporal Gulch region there is a small belt of gold-bearing quartz veins, the Gringo Mine presenting the most notable example.

The district embraces a half dozen or more camps, with a score or more of small mines and prospects, and several hundred likely claims to be given attention. There may be enumerated the Gringo, Happy Jack, Anaconda, Mansfield Group, Ivanhoe, American Boy, Victor, Castle Butte, Viceroy, Hosey, Castle Butte, Burro, etc. The

GRINGO MINE,

a gold producer, is in the southern part of the district, about three miles northwest from Patagonia, at an elevation of about 4,200 feet. The discovery was made in 1893, but no work of any consequence was done until 1906. For a time a five-stamp mill was in operation. Later an additional battery was installed, and increase to twenty stamps is contemplated. The property embraces a group of nine claims extending 4,500 feet on the veins, of which there are two running through the ground—the Gringo and the Independent. The principal development is in the Gringo vein, which is five to twenty feet in width, nearly vertical in position. The vein filling is quartz. The ore body goes as wide as fifteen feet, all good milling ore. The gold is fine and well disseminated, although the higher values are next to the footwall. The rock runs about \$10 to the ton in gold, carrying also a little silver, lead and copper.

The Independent vein, about 600 feet from the Gringo, and approximately parallel, is in general fifteen to twenty feet in width, and at the junctions of several spurs it widens to about forty feet. The spurs

make as good a surface showing as the main vein. The Independent ore averages about \$9 per ton. The plates recover about \$5 per ton, while a greater part of the remaining values are saved by concentration. The ore bodies are very large and will supply production through a long period of time.

Development is by a shaft 180 feet deep in a deep depression in the ground. Two levels extending several hundred feet east and west make depth rapidly and as extended give increasing backs. Other shafts on higher ground are sinking, but no deeper than a line level with the collar of the main shaft. The country rock is andesite, but by the veins, the filling in which is quartz principally. The

MANSFIELD MINES,

property of the Ruby Copper Company, successor to the Mansfield Mining & Smelting Company, are in Mansfield Gulch, a tributary of Temporal Gulch, about six miles north from Patagonia. The holdings embrace about forty claims. The principal development is on the Black Cap, Ruby and Sweet claims, aggregating more than 4,000 feet of work. At present operations are confined to the Ruby, where is the Lee shaft 425 feet deep, with drifting nearly 300 feet on the ledge in good ore. It is at the extreme west end of the group, near the head of the gulch. The Sweet Mine, which is at the lower part of the gulch, near Temporal, in which gulch lies the camp, has a 360-foot shaft, with levels 100 feet apart. The showing of ore is good. The Black Cap is opened by a shaft 140 feet deep, connected at the bottom with a 200-foot tunnel. Good shipping ore has been marketed from this property. Near the camp there is a small smelting furnace in which ores from the Sweet Mine were smelted. Work is progressing steadily and development accomplished gives promise of a great and profitable enterprise.

The country rock consists of quartz monzonite and rhyolite in chief, with andesite. Some of the ledges seem in contacts between the rhyolite and quartz monzonite. The

AUGUSTA MINE

is one of the so-called Hosey or Presidential Group, in the immediate vicinity of the Black Cap and Ruby. The group embraces seven claims, the principal work being on the Augusta. Upon two levels, 100 and 200 feet below the collar of the shaft, which is 215 feet deep, there are more than 1,000 feet of development.

Running through the property are three veins, the chief development being on the south vein, which is from eight to fifteen feet in width. A four-foot ore chute averages $12\frac{1}{2}\%$ copper, carrying a

little gold and silver. Through several months' time, under a former management, ore shipments averaged twenty tons a day.

Recently the property has been taken over by Mr. W. B. Ramsdell, an operator in mines of extensive experience, who is represented by Mr. Colin Timmons, a veteran mining engineer with wide experience in Colorado, Arizona and Mexico.

The new management has started a new working shaft on the same ledge at a point 300 feet east of the present shaft. The grading done for the new working shows a great ledge more than 100 feet wide, and as the ground rises rapidly above the shaft site, depth will be attained very fast. Every indication points to a great ore body below.

Upon another ledge, about 150 feet north of the old shaft, work of sinking upon another ledge is in course of prosecution, and it is at a depth of about 100 feet. The pay streak is thirty inches wide and it is yielding grey copper high in values. The work was commenced to perform the assessment work for the year 1915. The ore taken out from the first was so good that it was shipped at a handsome profit, and there has been no reason to stop. The

HAPPY JACK MINES

embrace a group of nine claims, not far south from the Black Cap property of the Mansfield group. The Happy Jack Mining & Reduction Company, of which Mr. W. H. Barnett, of Patagonia, is general manager, operates the property. Upon the dump there are several hundred tons of good concentrating ore, and there have been shipped a number of carloads of high-grade rock that averaged about 42% lead with $2\frac{1}{2}\%$ copper, twenty ounces silver and \$2 gold per ton. The ground is cut by several veins, the principal one, on which was done the development, being in the middle. The aggregate work exceeds 4,000 feet. The main or lower tunnel is 900 feet long, 400 feet below the croppings. The other tunnel is 200 feet higher. At 600 feet the two are connected by an upraise. The

AMERICAN BOY MINE

is in the same vicinity and northwest from the Black Cap. The owners, Jens Peterson and George Clarke, have worked the mine in a small way about ten years, making occasional shipments of high-grade ores. Development has been by tunneling. The

TYNDALL DISTRICT

lies upon the west side of the Santa Rita Mountains, and extends from the Rio Sonoita northward a distance of eighteen miles, a very small section of the area being in Pima County. The width of the district is about six miles. The region is rough and rugged, the three

highest peaks of the Santa Ritas (Mount Hopkins, Old Baldy and Josephine Peak) being at the north and east edges of the district, and the surface of the entire district is cut deeply by the canyons and gulches draining their slopes. Elevations vary from 3,500 to 9,000 feet. Geologically the district embraces a wide variety of formations, and the ore occurrences are extensive.

Tyndall District was the seat of some of the earliest mining of which there is any record on the Pacific Slope of the United States, cited in the opening pages of this bulletin; the Jesuit missionaries at Tumacacori having discovered and wrought the Salero, Alto, Montosa, Wandering Jew, and other properties as far back as 1688. American operation began with acquisition of the Gadsden Purchase in 1856.

The district embraces forty or more mines or groups of mines, many of them presenting extensive development and operations proceeding actively in quite a number.

They include the Alto, Apache, Arizona-Pittsburg, Aztec, Blacksmith, Bland, Bradford, Burro, Camp Bird, Connecticut, Conquest Group, Devil's Cash Box, Elephant Head, Eureka, Hermit's Home, Ivanhoe, John Allen, Joplin, Jumbo, Mary & Poltski, Montezuma, Montosa, M. & S., Rhode Island, Rosario, Royal Blue, Salero, Santa Rita, Sheehy Group, Tia Juana, Toluachi Group, Treasure Vault, Trenton, Wandering Jew, Vulcan, etc. The

ALTO MINES

present an extensive development and have been very richly productive. The ground included was among the early discoveries of the Jesuits, who are said to have continued operations in their primitive and desultory way rather steadily for about 150 years. Their facilities for development, ore extraction and reduction were crude and ineffective. Drill steel and blasting powder were unknown. With rough iron bars they drilled to depths of several feet into the rocks large round holes several inches in diameter, which were filled with lime, plugged securely and water poured in. The swelling lime rent the rocks, and when thrown out of place they were broken further with hammers. That process necessarily must have been slow and painful. Ores were packed to the surface on the backs of men, carrying rude rawhide buckets, climbing out of shafts on rude ladders, poles with notches cut into them.

Ores were smelted in rude reverberatory furnaces that were made from adobe, and after reduction the lead and silver were separated by a rude cupellation in the same furnace. In other regions where the ores carried gold and silver only the rock was milled with mercury in ar-

rastras, and the amalgam retorted crudely. Processes so crude were slow and laborious. They were possible only with a laboring population but little better than slaves, with wants limited and contented with a bare subsistence.

The property is located in the Salero region, about eight miles east from the Santa Cruz River, at Tumacacori, where are to be seen the ruins of the mission that was the home of the mining monks. About 1875 Mark Lulley, now of Nogales, located a part of the ground under the name of the Goldtree Mine. He sold it and there was taken out a great deal of high-grade lead-silver ore in the upper workings. A dozen years ago the property was made over to the Alto Mining Company, under which there was done a great deal of work, and that company was succeeded by the Santa Cruz Smelter, Mines & Transportation Company. Now the ownership is a subject of a complex litigation.

There are about 10,000 feet of work, several tunnels, with cross-cuts, shafts, drifts, winzes, etc. The ores in the lower workings are copper bearing.

The geology of the Alto hill is complicated, and a description would require too much space to serve the purposes of this bulletin. The

SALERO MINES

About three miles south from the Alto are *antiguas* also, wrought by the Jesuits long, long ago; and it was one of the first to which attention was turned after American occupation sixty years ago, there clustering about it traditions of some of the tragedies of Apache hate and ferocity. Until recent years it was in operation, a steady producer of high-grade lead and silver ores, but the death of the chief owners, following each other closely some years ago, caused suspension of operations, and the property stands idle. The

WANDERING JEW

group of mines is north from the Alto, on the next ridge. In the principal ledge there is considerable development, with a fine showing of lead-silver ores, manifesting the usual tendency to run into copper, the copper content increasing steadily as depth is attained. The Jew is in the same ledge as the Lee shaft in the Ruby Mine, on the east side of the main ridge, from which the Jew ridge is a spur, the ledge being traced readily across the mountain down the other side. The collar of the Lee shaft is lower in altitude than the deepest work in the Wandering Jew, and at a depth of 400 feet the Ruby is distinctively a copper producer. In the Wandering Jew the ore chutes are strong and

well defined. With more depth they are apt to yield a good copper output.

The owners of the Wandering Jew are Mark and Louis Lulley of Nogales, with R. R. Richardson of Patagonia. The property is under bond and lease to Holt Brothers, experienced operators, who have scored several successes in Mexico. They are shipping ore. The

TOLUACHI GROUP

north from the Wandering Jew, owned by Mr. Josiah Bond, includes the Jersey Girl, Silver Sally and Merry Widow. The principal work is on the Silver Sally, which has a shaft nearly 300 feet deep with a level at 220 feet. The ledge is about fifteen feet in width and has yielded ore that has averaged fifty ounces silver per ton.

The Merry Widow has a shaft 100 feet in depth, operating a vein from which ore shipments yielded 8% lead and 72 ounces silver per ton. The

BLAND MINE

is in the immediate vicinity of the Alto, lying southeast. Tunnels are the principal development, the lowest being 540 feet below the crop-pings, the aggregate work being 1,500 feet. Near the surface the ores were high-grade lead-silver, carrying copper; but with depth the lead diminished. In the early history of operation two carloads of ore shipped to El Paso and treated yielded 64% lead, 24% copper and 35 ounces silver per ton. Assays taken later from lower levels are reported to have run 8% to 12% copper, 6 to 15 ounces silver and \$3 to \$12 gold. Upon the two dumps there are measured 300 and 500 tons of ore, respectively, which show good values in copper, gold and silver.

The Bradford, Rosario, Montezuma, and other good properties are at the south end of the district, near the Rio Sonoita.

In the northern end of Tyndall District are the Devil's Cash Box, Sheehy Group, Conquest Group, Elephant Head and other properties.

Old Baldy and Greaterville Districts, on the north side of the Santa Rita Mountains, lie for the most part in Pima County, but the southern tips of each being in Santa Cruz. In Old Baldy District are the Curry properties, worked by the Six Metals Mining Company, running a concentrator and shipping copper concentrates.

The Greaterville District is chiefly gold bearing, with good quartz ledges and extensive placer deposits. Some of the placers are on the Santa Cruz side of the line.

Southwest from the Greaterville settlement, but within the County of Santa Cruz, lies an extensive deposit of onyx, owned by the Onyx

King Mining Company. The stone is very pure, beautifully colored and susceptible of a high polish.

San Cayetano District covers San Cayetano Mountain, between the Santa Rita Mountains and the Santa Cruz River. It embraces the Tubantia Mine, the Wise Prospect and some undeveloped ledges. From the Tubantia there has been shipped some ore.

In the region west of the Santa Cruz River the Atascosa Mountains are divided into three districts—the Sopori, covering the north end of the main range, the Pajarito District, on the south end, abutting on the Mexican line, and the Oro Blanco District, in outlying spurs on the west. In the Sopori District there is some prospecting, and in the Pajarito are the Raines Group, Clarke Group and Maloney Group of mines. In none of them is there anything doing. In the extreme west end of the county the

ORO BLANCO DISTRICT

has attracted attention through many years, and to a great extent its history is traditional. Vestiges of many *arrastras* show that it was worked for gold by Mexicans. It is about eighteen miles northwest from Nogales, and the famous Planchas de Plata Mines lie about ten miles south, in Mexico. The district extends about ten miles north from the international line, and its greatest width is about four miles.

Geologically the Oro Blanco country is classed as "late cretaceous," yet there are intrusions of igneous rocks, including andesite, rhyolite, dacite and quartz-porphyry. The mineral belt extends in a northwesterly direction. The chief production has been gold, and as there runs silver with it, giving the metal a lighter appearance than usual, it is known as "white gold" (*oro blanco*), from which the region takes its name.

Doubtless the first work was in placer ground, and there remain yet some good placers. During rainy seasons the natives find in the gulches and arroyos small nuggets and bits of gold. The presence of the ruined *arrastras* mentioned shows that the quartz ledges were worked at some time, whether by the Spaniards in the *antigua* days, or later by Mexicans, is a matter of conjecture.

The earliest record of American mining dates from 1865, when a man named Clinton Thompson was there working on what is now the Austerlitz Mine.

The quartz ledges are all strong and well defined, and in some parts of the region they are close and frequent. Gold and silver predominate, but copper is becoming manifest. In remote geologic time some great seismic disturbance rent, shattered and pulverized the rocks in all directions, and the interstices offered precipitation surfaces for the

vaporous solutions rising from the depths, which, cooling, precipitated and converted into the metallic ores that are found.

Near the international line there is a deposit of granite. In the southeastern part of the district there have been found extensive beds of potassium and potash. Oil-bearing shale is in evidence also. It is found near the camp of the Progressive Mining Company, springs of water showing oil float upon their surfaces. Whether the shale is an anticline or syncline has not been investigated. But if it is ever found to be a syncline, boring to the bend of the uptilted strata would produce oil, in paying quantities probably. The

PRINCIPAL MINES

are the Austerlitz, Switzerland, Ragnaros, Oro, Old Glory, Oro Blanco, Tres Amigos, Triangle, Warsaw, Franco-American, Grubstake, Yellow Jacket, Montana, Portland, etc. In some of them are extensive development with exposure of large and valuable ore bodies. In the early history of recent operations, thirty years ago or more, there were erected several quartz mills, but the processes seemed poorly adapted to the character of the ores, and they fell short in saving the values. All can be made to pay handsomely by installation of more modern and efficient extraction processes. The Oro Blanco Mine is said to have blocked out and ready for stoping many thousand tons of gold-bearing rock that can be made to pay well. Its owner is a banker in Scranton, Pennsylvania. The Old Glory shows above ground on one side a great gold-bearing ledge that is exposed to a height of 100 feet and a length of several hundred. From the ledge, which is about forty feet in width, gold-bearing rock has been quarried and sent down to the mill below. The mine has also considerable underground development. The

AUSTERLITZ MINE

has been a good producer, and it gives evidence of the making of a great mine. In 1912 Woodworth & Lane, who were working under bond and lease, shipped to El Paso and Pioneer smelters 1,414.5 dry tons of ore, and 180.4 dry tons of concentrates, for which they were paid \$57,223.44.

The Austerlitz and adjacent claims show on the surface an oxidized ore zone the ores from which average well in gold and silver, and often run to high grade. At greater depth there is penetrated a sulphide zone, the rock in which is extensive, massive and frequently high-grade, running well in silver, gold and copper. The deep-seated rocks are andesite, with an overflow of rhyolite. It is predicted that were the rhyolite cut through there would be found a great body of sulphide copper ores, rich in gold and silver.

The Austerlitz is owned by Doctor A. H. Noon, of Nogales, but at this writing it has been taken over under bond and lease by Mr. Camp-haus, an English mining operator.

In the extreme northwest corner of the Oro Blanco District is the Yellow Jacket mine, a gold producing property with a 10-stamp mill. It has lain idle twenty-one years, but recently work has been resumed by Mr. W. N. Gourley, of Philadelphia, whose deceased father's estate holds the title.

The foregoing pages serve to give some idea of the mines and mineral resources of Santa Cruz County. They are great and inexhaustible. To appreciate them investigation is necessary, which is invited.

ALLEN T. BIRD.



Bulletin No. 30

Safety Series No. 7

Geol
University of Arizona
Bulletin

CHARLES F. WILLIS, *Director*

State Safety News
June, 1916



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1915-16



State Safety News

Safety

Efficiency

SAFETY SERIES No. 7 .

JUNE 1, 1916

The Southwestern Mine Association has recently affiliated with the National Safety Council, in associate membership. This association with the National Safety Council in no way detracts from the individuality of the Southwestern Mine Association, but rather adds to its importance and the medium through which it may work. It is really an important step forward in the progress of the Southwestern Association.

The time is at hand when we must begin to think of the Annual First Aid and Helmet Contest, to be participated in by teams from all over the state. The State Safety News will be pleased to get opinions regarding these contests, where they should be held, under what rules they should be held, how many teams may be entered from each mine, suggestions as to how these contests may be made of more value. Let us hear from you relative to safety contests.

It is the chance takers who make widows and orphans.

WHY SOME ACCIDENTS OCCUR

By WALLACE McKEEHAN

My experience in accident prevention work has convinced me that the majority of accidents in mines, smelters, and upon the street, are caused by lack of forethought on the part of the injured man, by his failure to think quickly, and by his fixity of purpose. Most of us are so constituted that we cannot make a quick get-away even if the expected happens, and if the unexpected occurs, we stand rooted to the spot. A successful general plans to make a good retreat, just the same as he plans a good advance. I have known first class miners, working in bad ground, to carefully plan their attack, but utterly fail to make arrangements for their safety in case of a run or fall of ground. This happens in other lines of work as well as in mines. Quick thinking is something that we cannot all do, which is another reason why we should think beforehand.

Fixity of purpose is due mostly to stubbornness on our part in following out the thought that is uppermost in our minds. A miner sounds a piece of ground and concludes that it needs stulling. He gets the stull and starts to put it in place; with that thought in mind he forgets about the ground being bad, and takes chances in putting in the stull, that he should not take, for the very reason that he is thinking of the stull, not the ground.

A man starts across the street and hears the honk of an auto horn. Does he go back to the curb from which he started? No, not once in a thousand times. What he does do is to beat it across. For why? Because the thought that was uppermost in his mind was that he must cross the street.

Some months ago the driver of an auto started to cross the tracks of a railway, in the face of the fact that the crossing bell was ringing and that the locomotive had just whistled. After he was picked up from among the wreckage of his machine, he was asked why he did not stop. His answer was that he wanted to go across. If a hen could talk, she would most certainly give the same reason for crossing in front of a speeding automobile.

We talk about the education of workmen in Safety First, and that 70 to 80 per cent of all industrial accidents are due to their taking unnecessary chances—and then we calmly dodge autos, street cars and locomotives and think it all of the days work.

Personal caution is the greatest of all means of preventing accidents.

ACCIDENTS AT ANACONDA

The Bureau of Safety of the Anaconda Copper Mining Co. has compiled the following data on accidents at its properties during 1915:

	Per cent of fatal and serious accidents.	Per cent of all accidents, in- cluding slight.
Falling ground and rocks.....	42.8	32.2
Handling timber, tools, pipe, etc.....	16.4	17.9
Ore cars and trains.....	14.8	8.7
Falling timber, tools, etc.....	4.1	4.2
Men falling through floors.....	6.8	3.1

The following tabulations give the accident rates per 10,000 shifts for each quarter of the year 1915. The accidents considered include all on the surface and underground of the classes given that occurred in the metal mining department:

	Fatal	Serious.	Per cent reduction by comparison with 1st quarter.
First quarter.....	0.09	1.83	....
Second quarter.....	0.17	1.52	17.0
Third quarter.....	0.09	1.03	43.9
Fourth quarter.....	0.05	0.89	51.4
Average for the year, all mines..	0.10	1.32	27.9
Anaconda group.....	0.10	1.42	25.3
B. & M. Group.....	0.10	1.21	32.4
Southern Cross Mine.....	....	0.57	....

Over 50 per cent of the injuries caused by falling ground was due to carelessness of the men themselves.

*Because you have eternity before you, do not
plunge into it to save a minute.*

GARDENS AS AN AID TO HEALTH

One advantage of living in many mining villages is that each house has a yard, so that a garden is possible. Many persons who live in large tenement houses in a crowded city would greatly appreciate the miner's yard.

Miners can get great pleasure and profit from their gardens. Fresh vegetables from one's own garden always have a better flavor than those bought at a store. Many of these vegetables can be stored for use during winter. The garden helps to reduce the cost of living.

Some interesting contests may be arranged in connection with gardens. In one mining village five miners got together and paid in \$2 each and this prize of \$10 was to be given to the one who had grown the heaviest tomato by a certain fixed date. The contest aroused so much interest that the following summer 20 miners joined the tomato club.

If a garden is started at the right time and cultivated in the proper way, the work is not difficult. Fifteen or twenty minutes spent each evening among green growing things is restful for the miner who has spent the day in the mine, where all is black and where nothing grows. Days when there is no work at the mine may be spent with profit in the garden. Often these idle days are a burden, and the miner, simply because he has nothing better to occupy his time, spends these days in ways that do not pay.

The gardens will keep the children out of mischief and teach them thrift and a knowledge of nature and her ways. It will furnish a healthful and pleasant diversion for the miner's wife and will be a means of getting her to spend more of her time out of doors in the pure air and sunshine.

A garden greatly improves the appearance of the yard. It banishes disorder. It shows up uncleanness by contrast. What a difference between an ugly, barren, dirty yard and one that has a neat, well-arranged flourishing garden. The garden and lawns help to make a cleaner house. They reduce the dust nuisance. This feature is important, as will be seen later on when pure air is considered.

*Always think, set, and act the Safety Example.
Let one accident prevent another. Profit by
the experience of others.*

CIGAR CUTTERS AS TRANSMITTERS OF DISEASE

Bacteriological studies recently made at the Research Laboratory of the New York City Department of Health showed that diphtheria bacilli could be recovered from a cigar cutter which had been used to cut the end off a cigar previously held in the mouth of a person ill with dyptheria. Other bacteria could be similarly recovered.

It is the practice of many persons before using a cigar cutter to moisten the tip of the cigar with the lips before cutting it off. It is evident that there is a possibility of disease being transmitted in this way through the use of common cigar cutters in tobacco shops. There are a number of different types of cigar cutters being used. In some, only the knife blade come in contact with the cigar. In others, the end of the cigar presses into a conical socket and the knift cuts off the projecting end. If cigars are moistened in the mouth, the type of cutter in which the cutting edge only comes in contact with the cigar would not be apt to carry much infection; but the cutter with conical socket would be very likely to transfer the saliva of persons wetting the cigar to the cigar of the next person using the cutter.

The New York City Department of Health has suggested that the moistening of cigars before cutting be dispensed with as unnecessary, and that only cutters of the first type be used. A conference with proprietors of retail cigar stores has been proposed, when the desirability of having sanitary cigar cutters will be presented to them.

—Safety.

*Everyone on Life's highway should get the
habit, the good habit, the right habit, the
Safety Habit.*

One of the most instructive things in Technical Paper 129 published by the United States Bureau of Mines is the classification of accidents by mining methods. It is well worthy of study by all mining men, for it indicates what to look out for. Overhand stoping, for

instance, has a wide range of application and is used extensively in both wide and narrow ore bodies, with inclinations ranging from 10 degrees to 90 degrees. As regards safety, overhand has some advantages over underhand stoping, as the men always work close to the roof so that they can easily test it. In underhand stoping, the men sometimes work 50 or 75 feet below the roof, so that they cannot ascertain its exact condition by sounding.

The hazard due to explosives is not so great on wide ore bodies, probably due to the fact that less powder is required to break the ore than in narrow, tight veins. The dust question, however, is more serious in overhand stoping.

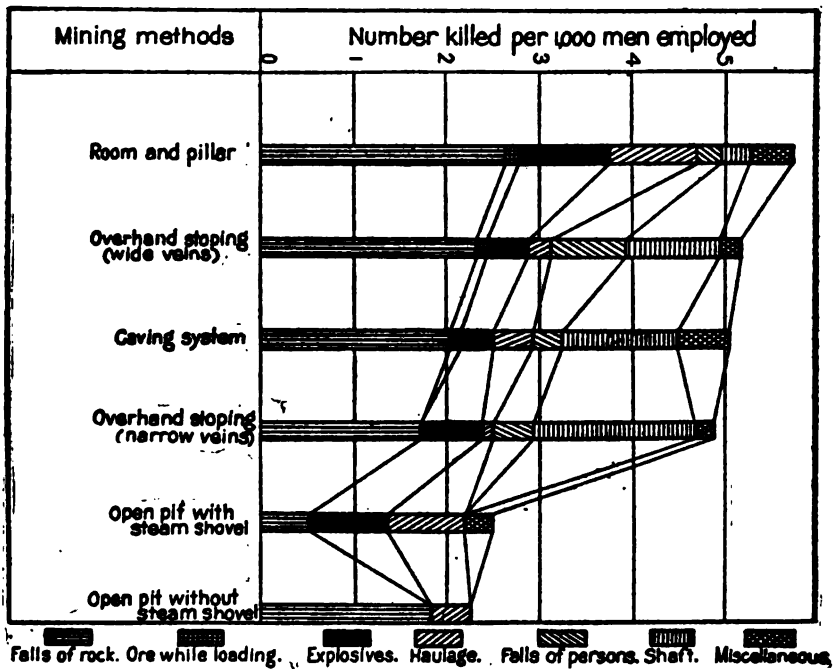


FIGURE 1.—Fatality rates compared by causes of accidents and by mining methods.

In the caving system fatalities are less than in other systems, although slighter injuries increase.

A careful analysis of the diagrams will show one what he has to look out for, particularly in the method of mining under which he is working, and a close perusal of Technical Paper 129, of the United States Bureau of Mines, entitled "Metal Mine Accidents in the United States During 1914," is worth while.

OLD DOMINION MINE OFFERS FIRST AID MEN LARGE PRIZES

Valuable prizes are to be awarded by the Old Dominion Copper Mining and Smelting Company in a series of First Aid contests to be competed for by teams representing the mine, the smelter and the mill. This action was decided upon when it was discovered that since the installation of the idea accidents have decreased by an astonishing percentage among the graduates of the course given by Chief Orr Woodburn.

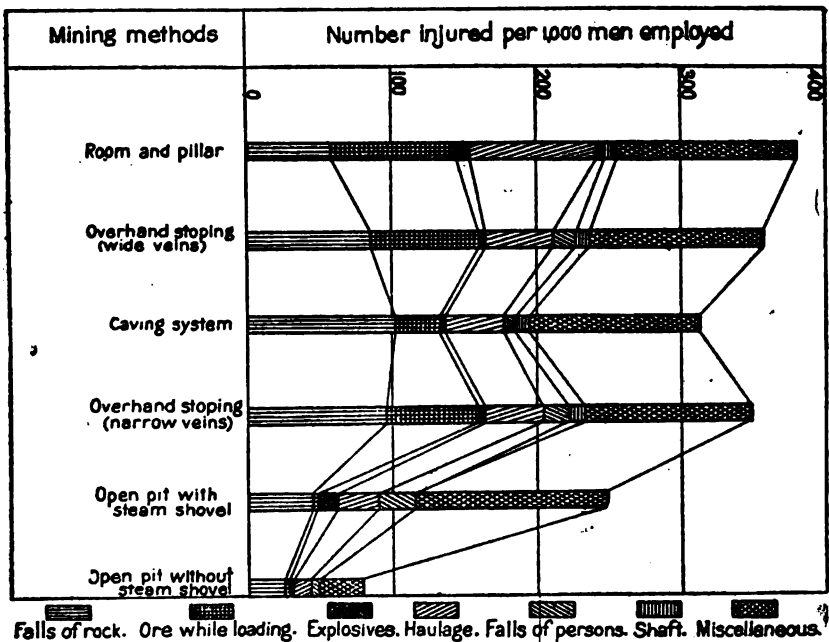


FIGURE 2.—Injury rates compared by causes of accidents and by mining methods.

Two prizes will be given to each of the three divisions of the workers. In each instance the capital prize will amount to two week's vacation at full pay for the six members of the winning organization. The second prize will consist of a vacation of one week at full pay. For each of the groups these awards will amount to \$637.50, representing a total cost to the company of approximately \$1,900.

There are no strings attached to the offer of the mine officials, as it is merely an appreciation of the results obtained under the new system as well as a concrete way of recognizing the interest displayed by the men in the various phases and application of the principles of the work.

In the matter of prizes the company has departed from the usual custom of donating cups or small cash rewards. An inkling of the regard in which the First Aid is held by the mine management is gained when it is considered that the state contest held in Bisbee netted all the successful entrants but \$800.

No other portion of the state can show the results attained here under the supervision of Mr. Woodburn, formerly government expert. This is due, if course, in a large extent to the facilities furnished by the company, but in a still greater degree to the unprecedented co-operation and assistance of the employees.

According to the present schedule the competitive events among the teams of each of the separate groups will be finished June 5. The champions of each of the divisions will then meet for the purpose of establishing the supremacy of one of them on July 4th.

*The brain power developed in a factory counts
for more than the horse power.*

SHARING PROFITS WITH EMPLOYEES

The results of an extensive investigation and analysis of more than 200 profit-sharing plans in the United States has just been made public. The work was undertaken as a result of the widespread interest taken by employers in efforts to establish plans for sharing with employees earnings in addition to fixed regular wages. It was found that many of the experiments had been abandoned as acknowledged failures; others are still in existence, with varying degrees of success, and differ widely in their methods. The views of many labor leaders were obtained and are unanimous in opposition to the general theory of profit sharing, as they claim that the employers' real interest in such plans lies in their alleged usefulness as a means to weaken and disrupt the trade unions. In other words, the trade union has been and is resolutely for the payment of wages according to a certain fixed rule of so much per hour or day per man, no matter whether this work is better than that of another man or not.

About one-third of the companies of whose plans have been analyzed by the Federation report that they consider profit sharing a success. Others presumably hold the same view, as they continue the experiment from year to year. *Among reasons given by employers for their faith in the idea are that it promises more continuous service, reduces cost of production, secures more regular attendance at work, builds up confidence and creates a spirit of co-operation, gets rid of rolling stones and encourages home building, promotes efficiency, interest and loyalty and increases the profits of the business.* Surely with such results obtained by many companies, further investigation of profit sharing will be worth while and publication of the full report of the Federation, which, it is announced, will be in book form, will be awaited with interest by many who are interested in this important subject.

The method adopted by a number of the larger copper companies in adjusting wages meets with general approval. Wage schedules are now based by these companies on the selling price of copper, the wages of their miners having already been increased from 5 to 20 per cent over those when copper was selling under 15 cents a pound—*Mining World*.

Ability is developed, not born. Men who possess ability are those who have studied to get where they are.

GOOD TEETH—GOOD HEALTH

You can save yourself pain, money and possibly ill-health by regular care of the teeth.

Common sense tells you that you have your good digestion only when your teeth are strong and sound—able to chew your food thoroughly. It is a scientific fact that men and women with healthy, clean mouth *do their work more easily* than those suffering from tooth troubles.

Tests prove that children will make faster progress in school if their teeth are in good condition.

Spend two little minutes a day now and avoid years of regret later on. Brushing your teeth when you get up in the morning and just before going to bed at night will repay you over and over again in comfort, health and appearance.

Your teeth are good workers—give them the help of three simple, inexpensive tools: (1) a tooth brush. (2) a good dental cream (3) water.

About every six months it is worth while to let a dentist inspect your mouth to see if special attention is required.

It is better to take pains with your teeth than to have your teeth taken with pains.—National Safety Council Bulletin.

It takes all kinds of fools to make a world, including the kind that wont use Safety Devices.

THE CHANCE TAKER

By MR RALPH C. RICHARDS,

Chairman Central Safety Committee, Chicago & Northwestern Railway Company.

The following splendid appeal for co-operation in accident prevention was recently made by Mr. Ralph C. Richards, to the employees of the Chicago & Northwestern Railway Company:

TO ALL EMPLOYEES

We all know the chance-takers—the men who do not go back to flag, the men who do not handle train orders as prescribed by the rules, the men who run by signals, the men who leave cars on the side tracks too close to clear, and the men who move cars on loading tracs without giving occupants ample warning and time to get out, the men who fail to block their frogs and guard rails, who fail to clean up their tracks and pile the material six feet from the rail, men who pile boards and cleats with protruding nails in places where men will step on them, or neglect to turn the nails down, the men who leave their baggage trucks too close to clear a man on the steps or side of a car, the men who leave their freight and baggage scattered all over the platform for passengers and employees to fall over, the men who do not put out the blue flags and lock repair track switches when under cars or engines repairing or inspecting the same, the men who use defective tools and jacks, the men who refuse to wear goggles, the men who throw away the guards on emery wheels and gearing of cars, who do not keep an alert lookout for moving cars while working about trains, in yards and at stations, and who walk between the rails, who get on engines coming toward them, and who do all kinds of careless, thoughtless things that make cripples, widows and orphans, but rather to say anything to them or report them, we take the risk of being killed or injured by their carelessness.

Why not change this policy? Get after these chance-takers and teach them to be careful or drive them out of the service before, and not after, some one is killed or injured. It may be you. "Safety."

Pull yourself out of the "Danger Habit." Do your work the safe way, use the guards and cut out accidents.

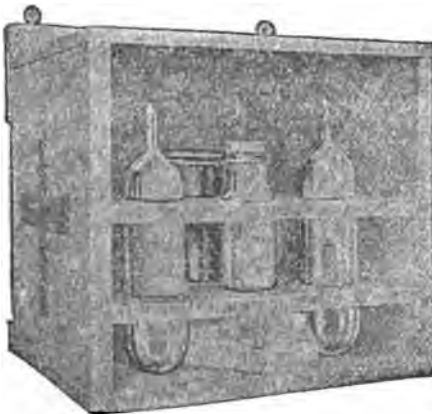
TO SAFETY INSPECTORS

A book has recently been published called "Industrial Accident Prevention," by Davis S. Beyer, which is worthy of close perusal by all those interested in Safety. The book is a Houghton Mifflin Co. publication, and may be obtained by writing 4 Park St., Boston, Mass. The selling price is \$10. It should be in every library.

*Stop—Look—Listen—Think before you act.
Keep your mind on your work and avoid accidents.*

INDUSTRIAL

The Braun Corporation of Los Angeles desires to call attention to something new in an outfit for a cyanide poisoning antidote. The outfit contains everything ready for use in case of poisoning, con-



Cyanide Antidote Cabinet.



Hayward Respirator.

veniently put up in a small wall case, and is cheap enough to have hanging in several places in the cyanide plant. The chemicals are in sealed glass containers, which prevent deterioration.

INDUSTRIAL

PROTECTION FOR HANDS OF WORKERS

Analysis of industrial accidents and their causes show that the hands and fingers are more frequently injured than any other member. As the hands are constantly employed in the majority of industrial processes, it is usually just as important that the workers' hands be safeguarded as the machine at which he works.

The exception to this rule is when working around rapidly moving machinery. Then the ordinary glove is distinctly dangerous, as it may be caught in revolving parts, dragging the hand with it and causing the loss of one or more fingers.

In chipping castings or work at the grinding wheel, many painful accidents to the fingers and knuckles are likely to occur. Protection is required for the thumb, forefinger and the first two knuckles at the base of the fingers. Yet it is essential that the worker's hand be unencumbered by a clumsy glove for the accurate and safe handling of his tools.

A strong serviceable and pliable glove meeting these requirements is now being made by W. H. Salisbury & Co., Inc., Chicago, who in perfecting this glove had the cooperation of a large manufacturer of castings, based on practical shop experience.

Another glove manufactured by the same company, and designed for general foundry and shop work is shown in the accompanying illustration. The thumb, usually the weakest point in a glove, is sewed in with steel ribbons and cannot pull out. Additional strips of tough leather sewed in with steel thread reinforce the palm and fingers and assure the worker of comfort and protection in sand blasting, grinding, handling castings, heavy bars, sheet metal and other rough work.

These gloves which meet practically every requirement for safety and economy have recently been accepted for exhibit at the Mesuem.. "Safety."

First aid to the uninjured is Safety First.

First aid to the injured is Safety Last.

CHANGES IN RULES

By DUANE REBSTOCK

Paragraph Q, "Time will not be an element unless the team or men performing exceed the allotted time or fail to give treatment properly. All events will begin and end at the sound of a gong or other audible signal," might be made to read:

Time allowed will not be an element unless the team is too fast and fails to give treatment properly, or exceeds the allotted time. All efforts should tend toward having the time allowed sufficiently long to actually dress a real wound and each team should be supposed to be illustrating what they would do in an actual case and be judged accordingly. In problems where special permission is given, teams can use jumpers, etc., at will or regulation material if they so desire, but in any and all cases they shall be judged by the actual effectiveness of the work and the comfort of the patient in actual distress. All events will begin and end at the sound of a gong or other audible signal.

Paragraph B, "The teams will be numbered consecutively, beginning at number one, and they must occupy the positions assigned to them on the field," might read: Each team shall be numbered consecutively, beginning at number one. Their number and corresponding position on the field shall be determined by lot. No banner or other mark of identification shall be seen on the field.

Discount No. 8: Insecure or granny knot.....4. Anything but a square knot," might read: Insecure or granny knot. Anything but square or surgeons' knots.

Paragraph "T"

- 1 Each set of judges shall mark the team and set numbers,
- 2 event, discounts for each team, sign their names and deliver the score cards to the chief judge after each event;
- 3 he, in turn, will deliver them to the recorders to be checked.
- 4 Suitable record cards, for the use of the judges, shall be
- 5 provided by the chief judge the day before the contest.
- 6 The recorders will add the discounts and mark the percentage made by each team in each event. All percentages
- 7 will be figured from a Full Team Score as a basis; thus—
- 8 1 Man Event; discounts 8 ($8 \times 0.2 = 1.6$) being 1-5 of a full
- 9 team—equals 1.6; this amount from 100.0% leaves a net
- 10 percentage 98.4; in like manner the 2, 3 and full team
- 11 scores would be arrived at by multiplying the discounts by
- 12 0.4, 0.6 and 1.0 respectively. The average of the individual
- 13 net scores will be the final score of the team.

from line No. 9 might read: The score in any event shall be the sum of the discounts subtracted from one hundred. The final score for the contest shall be the sum of the individual scores decided by the number of events.

What the association needs is not so much money as good, intelligent, active interest.

Don't be asleep on the job, do something, and just now that "something" is to get a good set of rules for First Aid contests. Take some sort of a stand and let the association know about it.

A copy of the association rules may be had from the secretary of your Safety Department. Get one and write your opinions on the margin and send it in. If you support the association rules, good; if you support my substitutes so much the better, cut out the page and send it in; if you have some suggestions of your own, let's hear them.

DO SOMETHING RIGHT NOW! TODAY!
DO SOMETHING! RIGHT NOW!! TODAY!!!

OIL AND GASOLINE

Oil and gasoline are used at mines for many purposes, and frequently cause fires which are difficult to put out. A soda-foam is now on the market that will extinguish fires in receptacles containing from a gallon to a 55,000-bbl. tank. Foam has many distinct advantages. It can be thrown to a distance of more than 30 feet, and can be used on highly inflammable liquids without spattering them or without spreading the fire in the least degree. It floats on the lightest oils, and, being discharged in a state of continuous expansion, it spreads itself completely over an oil surface in the form of a blanket, entirely shutting off atmospheric oxygen from the burning surface. In its application as a stream, or jet, none of the carbon dioxide is lost in transit. This gas is carried in minute gas-bubbles direct to the seat of combustion in the form of a foam blanket, which remains for almost an hour. The foam has a cooling effect on all fires, but is especially noticeable in oil fires, the oil being cooled below flash-point, thereby preventing re-ignition. The foam is adhesive, sticking to ceilings and walls, or anything upon which it is thrown, and there remains until long after the fire is extinguished. The foam damages nothing and can be readily removed by washing. For small fires the mixture is sold in apparatus similar to the ordinary fire extinguishers.

A GOOD LODGEMAN

Protects his brother. Visits the sick. Helps those in trouble.
Buries the dead. Cares for the widows and orphans.

A GOOD SAFETY MAN

Safeguards his fellow workman. Prevents sickness and death. Saves
men from trouble. Reduces the number of funerals. Lessens the
number of widows and orphans.

WHY?

Should not every good lodgeman be a booster for *Safety*.

.....1916

J. T. MORE, Secretary,
SOUTHWESTERN MINE SAFETY ASSOCIATION,
Ray, Arizona.

Enclosed please find ^{money} order for Three Dollars (\$3.00)
check
for membership in the Southwestern Mine Safety Association for
the year 1916.

Address.....

.....

Bulletin No. 31

Safety Series No. 8

Geol
**University of Arizona
Bulletin**

CHARLES F. WILLIS, *Director*

State Safety News
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State Safety News

Safety

Efficiency

SAFETY SERIES No. 8

JULY 1, 1916

FIRST AID CONTESTS

By JOHN S. BOARDMAN, Anaconda Copper Mining Company.

First of all I will say that we had not thought of sending a first aid team out of the state this year and at this time it is impossible to say one way or the other whether we could send a team to a National contest.. However I wish to give you my views on this matter of first aid contests, with the hope that we can all get together on some basis that is scientifically correct and thus eliminate the waste entailed in first aid contests.

In the first place, it is well known that there never was a first aid contest in which everyone received their just dues. Even granting that a fair system of judging a contest could be devised and adopted, the large majority of the men participating will work as hard as the winners and yet receive no recognition whatever. Now if first aid contesting were a game practiced solely for the purpose of amusement this condition would be just and acceptable.

In the second place there has never been a first aid contest in which everyone concerned believed that all received a square deal and I might add that in every case there has been good grounds for such belief. I do not say this with an idea of charging anyone with unfairness but it is, nevertheless true and it is due to the fact that unless the patient is actually injured and each patient has the same injury, received in the same manner and has the same physical temperament and the dressings and treatment applied by each team are inspected by the same judge or committee of judges, there can never be a fair system of comparing the first aid ability of different teams. Of course this is an impossibility.

Now from the fact that heretofore so many men have given their time and effort to the work, when they have known that, even should they be fortunate enough to win first prize, they would not, by the prize, be compensated for even a small fraction of the time and effort spent, it is proved that with proper leadership these men would make an equal effort for the work alone.

The purpose in holding a first aid contest is, as you know, not to benefit particularly the contestants, but to advertise the work to the

general public. The public can be as well served and the hazard of creating ill feeling can be eliminated by another method. Let us then be square with ourselves and remove the work from the false, and therefore insecure base, cut out the contest feature and put the good work where it will stand on its own merit.

With the realization that first aid should, in order to be efficient, include also, prevention of accident and disease, better social intercourse and greater personal efficiency among first aid men, could not some system of organization be effected whereby the first aid men will be rewarded and encouraged in proportion to the good that each actually accomplishes; in which better social and educational conditions among miners might be brought about in which we could all have the benefit of any experiment or experience that might come along.

In case such system could be devised and generally adopted, all money spent on the work would be efficiently used to directly benefit the men who contribute the money and those who do the work. For instance, you mention \$5,000 or \$6,000 as being the probable cost of the proposed Detroit contest. As you say this amount might be excessive but you must consider also that concerns as far away from Detroit as yours or mine would be put to the additional expense of about \$1,500 in sending a team to participate in the National contest and this money would benefit only such of our people as might be fortunate enough to win the trip.

We are at present, working with the end in view to devise a system that will be founded on the right basis and will give to all concerned the proper encouragement and at the same time use the money that the work will cost, to the best advantage of all concerned. One of the ideas I had in mind upon which I have spent some serious thought was something like the following:

First, establish as a part of the Mining Branch of the National Safety Council, a National First Aid Society. Second, establish at each mining town a Local First Aid Society, chartered under the National Society, outline duties, rules of order and by laws for such local societies, permitting of course such local additions as might be necessary so long as there is no conflict with the laws of the National body. Then last and most important of all establish a uniform classification of injuries with a specified scale of credits for proper first aid treatment of each class of injury so that when any man has performed first aid in a sufficient number of cases to earn a reward as specified, give him such recognition as his work shows him entitled to receive.

The contest feature has served its purpose of interesting the public in this work probably better than any other thing could have done but now the work is so thoroughly established or rather advertised that it has become national in scope and from the very fact that there can be no just means of judging the superiority of one team over another except by the impossible plan mentioned above, if something is not done within a very short time to put this work on a live and efficient basis we will find ourselves in the position of some of our more fanatical evangelists, simply training men and loosing them only to train more men and lose them and the last condition of these men is worse than the first.

*The failure to obey safety rules endangers the
the life of yourself or fellow workmen.*

SAFETY AS A MEANS OF BETTERING RELATIONS BE- TWEEN THE PUBLIC AND PUBLIC- SERVICE CORPORATIONS

"We have reached the time when, with few exceptions, the public service corporations have established better relations with the public than existed some years ago. For a long time, neither thoroughly appreciated their relations to the other and both, seemingly failed to recognize that their interests were largely mutual. It is, therefore, not the question of safety bettering their relations, but rather of safety improving the better relations already existing.

"A public service corporation to be successful, must necessarily have for its field operation, one or more progressive communities. On the other hand, no community can progress to any considerable extent without it is adequately supplied with the different classes of service furnished by the various public service corporations. The appreciation of both during the past few years of this interdependence on each other has, undoubtedly, led to the marked improvement in their relations. The successful public service executive of today is a man of broad vision. He is in touch with the best civic requirements of the communities he serves and is ever ready to help toward that development, which is equally as necessary for their success as for that of the corporation which he represents. It is unusual not to find his Company amongst the leaders in any movement—industrial or social—organized for the betterment of present conditions. And so, year by year, the public service corporations and the public have been drawn closer and closer together by ties of mutual interest, having for their final object, their individual and mutual advancement.

"Unfortunately, however, the continued progress toward this much desired end is retarded by a condition which has increased rather than decreased during the last decade. We are all familiar with that questionable class of personal injury suit, without real merit, and in which the damages sought are magnified in every way by all parties in interest. As a matter of course, these cases of really manufactured injury, for which money is the sole and immediate remedy, have no relation to those unfortunate and meritorious accidents in which the injury is real. Overcoming this wretched condition, or diminishing it will help materially in furthering more and more pleasant relations between the public and the public service corporations.

"The safety movement, by eliminating the possible causes of accidents, by the education of employes to prevent, and of the public to avoid accidents, must result in, at least retarding the growth of this evil. A better understanding by the general public of the efforts of public service corporations for the safety of their life and limb, would have a great moral effect in helping to stamp out, both in their inception as well as at their disposition before a jury, these unreasonable claims which are, at the best, based on a shadow of facts. This would not only be of benefit to the corporation, but also to that large proportion of the honest public whose only accident claims are those made when real injuries are suffered.

"The public, as a whole, do not seem as interested or as helpful as they should be in the efforts taken by corporations for their safety. If anything, they resent them as an infringement of their personal rights, rather than welcome them as a protection for their life and limb. Many a time we have seen the passenger on a street car objecting to the efforts of a careful conductor to prevent him or her from taking the chance of being injured by leaving the car before it stops, or by stepping down in front of a passing vehicle. This practice of getting on or off moving cars was the cause of such a large percentage of street car accidents that in order to protect the public against their own carelessness it became necessary to construct cars with doors and steps so controlled by the motorman or conductor as to make it impossible to board or alight therefrom while the car was in motion. It is an everyday occurrence to see people, and probably some of us here, have at times been guilty of walking across railroad tracks in front of an approaching or standing train, around lowered gates, provided by the railroad company for our protection. The number of people killed as a result of trespassing on railroad rights-of-way placarded as dangerous and properly fenced in, have been so numerous that, in some states, it has been made a misdemeanor,

punishable by fine and imprisonment. Notwithstanding all that has been said and written about the dangers of touching fallen wires, we quite frequently read in the pages of the press of people being electrocuted as a result of so doing. Rules and regulations, made by the public service corporations for the protection of the public, and for that of their employes, are, in spite of close supervision, constantly broken with a resulting list of accident reports daily coming in to the Safety or Claim Department. The extravagant disregard for the value of their safety is shown every day by the public on our city streets and in public places. During the automobile season, our papers are constantly reporting terrible accidents, invariably caused by suicidal carelessness. And so we might go on infinitum, recounting preventable accidents for which the public itself is entirely responsible. It is, therefore essential that from a humanitarian as well as an economic point of view, the public service corporations should deeply interest themselves, as they are doing, in the great safety movement that has in a remarkably short time spread itself all over this country. To avoid the unjust claimant from taking advantage of them, and to protect the honest public against its own carelessness, they cannot afford, within the limits of good business judgment, to leave anything undone that will add to the safety of their service, their patrons, and their employes. They cannot develop any well defined safety movement amongst their employes and secure their interests without it being reflected in a more considerate and courteous treatment of their patrons. This, with the reputation of safe service, which the safety movement must eventually develop, will, through the number of friends it gains for the corporation, tend to further improve its relations with the public.

"How can this safe service be secured? Certainly, the use of well tried safety devices for the protection of employes and patrons are necessary, as well as the enforcement of proper safety rules and regulations. These alone, however, judging from the few instances mentioned and the experience of public service officials, as well as executives in other branches of industry who have studied accident prevention, will not insure safety. What is needed above all else is the co-operation of the individual whose safety you are endeavoring to conserve. This can be obtained only by education along safety lines. The education of the employes is comparatively simple when once you have aroused their interest. Experience proves that this is not a difficult task, as, in every man their lies dormant, not only the spirit of self-preservation, but also the more unselfish and higher spirit of the preservation of his fellows. The more difficult problem

is the education of the public in accident prevention, in general, so that they will appreciate that the safety rules of any service or industry are solely for their protection and not with any idea of restricting their personal rights.

"There is nothing mysterious in the safety movement; it is a simple, common-sense proposition dealing with a particular form of conservation of the human body, based on humanitarian as well as economic motives. The more thought and study one gives to accident prevention, the more one is impressed with its simplicity and the necessity of education along purely general common-sense lines, so that each individual will learn to use the necessary precautions in preventing accidents to his or her own body, and that of others. Education along the lines of general accident prevention should start in the kindergarten and be carried through the high school and the college. By studying the accidents occurring in any branch of public service or industry, you will find a large percentage of them are common to all. They are the everyday kind of accidents that might happen anywhere due to lack of caution and thought. The accidents chargeable to any public service or industry resulting from the hazards of that particular business, are small in comparison. Some statistics, recently gathered together, of accidents in the electric industry showed that less than twenty per cent were really chargeable to the hazards of the business. Even most of these could have been avoided by ordinary care and thought. We are all too reckless of our lives and limbs and instead of thinking safety first, are liable to think of it last and when too late. We are taught from childhood to build our bodies up by exercise, but the lessons of taking care of them, by caution, seem to have been overlooked.

"There is a good reason that a plea for accident prevention along general lines should be made, because until this is accomplished, how can the public service corporations, or the industries, expect accident prevention along special lines? While we, in our particular lines of industry, are endeavoring to educate the public in the prevention of accidents incident to that industry, we must assist in every way we can, in their education along the more general lines of accident prevention. The public service corporations can, through their close contact with the public, do a great deal in this campaign of education. It will take some time for the public to appreciate that the work is being carried on for their benefit, but when they do, they will be ready and willing to assist in any way they can. Working together, the public and the public service corporations in a safety movement

for the common good will come to a closer, and, if possible, a more friendly relationship than even exists today.

"This, I think, shows a very good reason for the railroad company taking the initiative and seeming to go outside of its organization in the furthering of the safety first movement. The carrying on of the safety work needs the enthusiastic co-operation of all." As someone has put it: "The enthusiast in the safety movement is he who knows he is working along the broad, humanitarian lines. He is aware that safety does not consist of a few speeches, a splurge of ink, and a moving picture show. These things help, but they alone will not suffice to pull men from the careless 'danger habit' of years. That takes time, thought and constant effort. Above all, it must be considered that when Indifference comes in at the front door, Safety flies out of the window. This fact makes plain the need for constructive enthusiasm, which is simply enthusiasm plus brains."

And, to conclude, *Safety First means, and its aim is: "That the workman shall live to enjoy the fruits of his labor; that his mother shall have the comfort of his arm in her age; that his wife shall not be untimely a widow; that his children shall have a father, and that cripples and helpless wrecks who were once strong men shall not longer be a by-product of industry."*

SAFETY— It pays to think before you act.

WORKMEN'S ATTITUDE

Headquarters:
208 S. LaSalle St., Chicago,
May 8th, 1916.

Dear Fellow Members:

No intelligent workman is antagonistic to safeguards and safety regulations when he understands them.

Recognition of the necessity of safeguards is an evidence of a level head. The fellow who thinks it is smart to take a chance or that he is above the "new fangled safety idea" is now looked upon as worse than a mollicoddle.

The faulty view of the personal hazard must be superceded by a safe and sane one, which recognizes the fallacy and danger of such reasoning and which places true values on the blessings of a sound and unmaimed body. Have you any men in your shop who are still living in the dark ages—in the time before telephones and steam engines—who have not yet awakened to the Safety Idea? Remember, they form the "danger spots."

Keep after them—swing their ideas to the proper view. Give them a place of responsibility on the Safety Committee. This will make them hit the sawdust trail of Safety.

NATIONAL SAFETY COUNCIL,
W. H. Cameron, Secretary.

Small neglects are apt to cause serious accidents.

CALUMET AND ARIZONA MINING COMPANY

THOS. COWPERTHWAIT, Safety Inspector.

A very good discussion is given in Bulletin No. 27 in regard to the advantage and disadvantage of the "Lay-off System." I believe that the lay-off system is the best system to acquire a trained force of men, and unless men are trained to be careful, safety work will never be a success. I would far rather see a careful man in a dangerous place than a careless man in a supposedly safe place. Our record for the past year shows that at least 75 per cent of our accidents have occurred in supposedly safe places of work, but the man injured had been careless. For instance a man starting to drill a hole and a small piece of rock falls and strikes his hand, a man driving a wedge and a small rock falls and strikes his hand, a man stands a post and does not brace it and it falls on him, a man pulls a car on his foot, or catches his hand between the car and timber. Such accidents occur in safe places but the man is careless in most cases. I believe the only method of preventing such accidents is to lay a man off for a few wdays when caught working under such conditions, and I also believe that inside of six months if the bosses are very strict along the lines of safety and use the lay-off system they will have trained men and their accidents will be reduced almost to a minimum. This fact has already been proven by some of our best shift bosses, and these shift bosses are much more liked by their men than others who have not been very strict in regards to laying off but would rather severely criticize their men when found working under such conditions. "Bawling a man out" as the miners term it is a thing of the past and if a shift boss is up-to-date this system will not be used, and if he is not up-to-date in this respect he should not be a shift boss for he will continually have accidents caused by getting his men mad and excited.

I do not consider the mining companies throughout this state are giving sufficient data to this Bulletin. I believe the record of accidents each month should be published. The attached form gives a

very simple way of recording these accidents, which contains all data necessary for comparison. These Bulletins are given to the shift bosses and foremen and if they saw that they were at the bottom of the list it would cause them to observe more closely and try to reduce their percentage of accidents. It is only natural that any man wants to show a good record and in this his record is known by all mining men throughout the state, therefore causing him to take notice and get results. This record is given by the State Mine Inspector each year, why not give it each month? I would like to see this discussed by the various safety inspectors of this state.

*Let every employee make himself a committee
of one to prevent some one accident.*

THE CARE OF THE STOMACH

Probably the greatest aid to a healthy life is a healthy stomach and the greatest assistance to the keeping of a healthy stomach is the proper care of the teeth. The following rules for the care of teeth have recently been compiled and are well worth following by those who are interested in "Safety First" from all points of view.

If the tongue is not clean, scrape it. Use a bent whalebone, silver knife or any article that will scrape without cutting.

Remnants of food lodged between the teeth should be removed either with a quill toothpick or a piece of floss silk.

The use of a small, stiff brush is generally advisable. The brush should be kept and used dry.

Do not continue to use a defective toothbrush. As soon as the bristles are worn or softened, throw the brush away. Many people use a new brush every month.

Use a good tooth paste or powder but not excessively.

Throw the head slightly back when brushing.

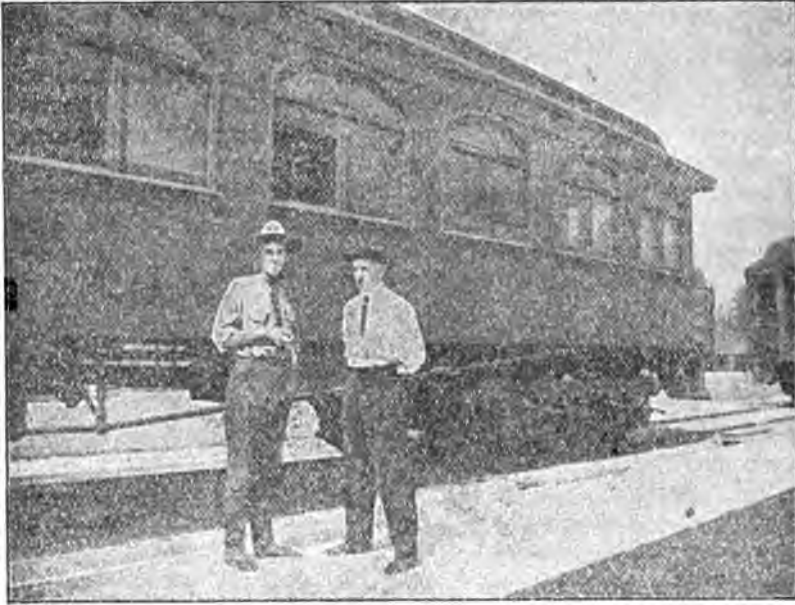
Work the cream or paste between the teeth and brush the teeth and gums briskly in every direction for two minutes. Also brush gently the roof of the mouth and the tongue.

Then take water in the mouth and continue to brush and rinse for at least a half a minute.

Make the toilet of the mouth after each meal or at least twice daily, after breakfast and before going to bed.

The teeth should be examined by a dentist at least every six months.

Follow this advice and you have made one of the greatest steps forward for personal health.



MESSRS. G. W. SALISBURY AND ORR WOODBURN WITH U. S. MINE
RESCUE CAR NO. 2

Mr. Salisbury now Safety Inspector, United Verde. Mr Woodburn
now First Aid Instructor Old Dominion.

MINE RESCUE CONTEST RULES

Submitted by CHARLES A. MITKE, Bisbee, Ariz.

1. Each mining company operating in the Southwest shall have the right to enter one team from each mining operation or district. The entry of more than one team will not be allowed.

2. Each team shall consist of five men, one of whom shall be captain. Any employe of any mining company may be a member of contesting team, provided that the one who has had charge of the contesting team during training shall not be a member of that team.

Note:—It is recommended that each team be accompanied by a trained man who shall act as substitute.

3. Each team shall perform separately. No team to observe another team perform unless they have already performed.

4. Before putting on the apparatus and before receiving the problem the pulse and respiration of each man shall be taken by a surgeon, who shall penalize or disqualify any man not in a fit physical condition for the work.

5. In case any member fails to pass the doctor's examination, the team will be penalized 5 points, and they will be given sufficient time in which to enter a substitute.

6. The captain shall command his men by word of mouth or signs.

7. If, during the performance of the event, consecutive members of the crew become separated beyond an interval of two yards, a penalty shall be imposed.

8. Equal credit given for the use of Helmet or Mouth Breathing Attachment.

9. Teams using mouth breathing apparatus shall bring their own.

10. Each team shall furnish their own oxygen, but the potash cartridges will be supplied by the Contest Committee.

11. Each team shall furnish their own lamps, both carbide and electric.

12. In case any problem submitted by the judges calls for the use of the Pulmotor, this will be supplied by the Committee.

13. Before the problem is drawn by the captain he shall see that the apparatus to be used shall be placed at a point convenient to each man.

14. Upon command of captain each man shall first examine his apparatus and make all such tests that will convince him that the apparatus is in proper working order, and put it on without assistance. These tests shall be such as are recommended by the Bureau of Mines and the American Mine Safety Association. It is suggested that due credit shall accompany all thorough tests that are made of the apparatus.

15. The captain shall inspect each apparatus, noting the number of each apparatus worn and the reading of the oxygen gauge. Rescuer No. 1 shall inspect the apparatus worn by the captain.

16. The oxygen pressure gauge on each apparatus shall register at least 100 atmospheres. For having less than this amount the team will be penalized 5 points.

17. In case of failure of any member of the team to remain in the smoke chamber the specified time, the team shall return to the point of entrance to the mine and shall be allowed to place their substitute team and retest the apparatus. The penalty for doing this shall be 10 points.

18. In case the apparatus leaks, the team will be penalized 5 points, and shall be given 10 minutes in which to make repairs. In case this time is not sufficient, the team will be disqualified and ordered from the field.

19. In case the apparatus used by the team is equipped with the oxygen bi-pas valve, this valve shall not be used, except in making tests of breathing bag; any member of the team doing so will cause the team to receive a penalty of 5 points.

20. Each 50 feet in the imitation mine used in the contest shall represent 300 feet under actual conditions, and the team must rest for a period of about one minute at these points. A sketch of the field and arrangement of the mine shall be supplied to all contesting teams.

21. No practicing shall be allowed on the field before the beginning of the contest.

22. When in the field for the contest work each contestant shall remain at attention, unless engaged in actual duty.

23. Any helmet man, or any person who has had charge of the training of the helmet team, who shall interfere with the observations of the Judge during the contest, his team will be penalized 10 points.

24. Any matter not covered by the foregoing articles and rules shall be left to the decision of the judges.

25. The judges shall keep a record of the work done by the different teams, the penalties, etc., and at the end of the contest work they shall compare their records and make their decisions.

NOTE:—Six problems or events may be arranged by the Rules Committee, these to be submitted to the judges the night previous to the contest. The judges shall select from these the same number of problems that there are teams entered. Each problem will be placed in a sealed envelope, one of which shall be drawn by the captain of the team after his team has been called on the field. Upon a signal from the judges the captain shall open his envelope and will be allowed three minutes time in which to instruct his men regarding the manner in which the problem shall be carried out. These problems will be such as are met with under ordinary mine fire conditions. No member of the Rules Committee shall divulge to any one the nature or character of these problems, nor make any suggestion or suggestions concerning the same.

METHOD OF PUTTING ON AND TESTING THE APPARATUS

(On account of the great difference of opinion in regard to the tests of the apparatus, and also on account of the arguments usually

arising at contests, the Rules Cimmittee offer the following suggestions as a standard method of testing and putting on the apparatus.)

1. Place the apparatus in order so that the helmet man shall face the back of the apparatus where he can readily take hold of the potash cartridge and oxygen cylinder.

2. Turn on the oxygen and read the finimeter.

3. Release potash cartridge and shake, and blow into cartridge, keeping one end covered with the hand. Also test both springs which allow the air to pass through the potash cartridge. Then put back potash cartridge.

4. Disconnect breathing bag from apparatus and make test for quantity of oxygen with the litre bag.

5. Make test for pressure of oxygen with the water gauge.

6. To test out the air tightness of the breathing bag, connect all tubes to breathing bag. In case the oxygen cylinder contains a bi-pass valve, turn on the oxygen with this valve until the bag is filled, then press the bag and see if it is air-tight. In case the oxygen cylinder has no bi-pass valve, remove the potash cartridge, turn on the oxygen, and with the thumb press the valve open which enters the top of the cartridge. After the breathing bag is full test for air tightness as before.

7. Put on the apparatus and connect the helmet to the apparatus. Put on the helmet and fix it securely on the head, also inflate the pneumatic lining so that no air will escape, then close the valve which connects the helmet to the outside air and at the same time grip the connecting tubes with both hands to prevent the air passing either way. Breathe into helmet to test for air tightness.

8. Open the valve connecting the apparatus to the outside air and after inhaling, close the valve and proceed to fill the breathing bag. After about five inhalations and exhalations, close valve and turn on oxygen. The helmet man is now ready to proceed and awaits the captain to make final inspection of entire apparatus.

METHOD OF RATING

At the beginning each crew will be credited with 500 points (100 for each member). The total of all discounts charged will be deducted from 500 and the remainder divided by five to ascertain the percentage of each crew.

The following discount will be made:

<i>A. Preliminary</i>		Points
1.	High pulse, for each member.....	3
2.	Failure to remain in smoke room, each member.....	4

3. Failure to name tests for apparatus, each test.....	5
4. Apparatus not properly adjusted to wearer.....	7
5. Loose joint or connection, each.....	10
6. Breathing bag flat, each apparatus.....	8

B. While Performing Event

7. Failure to maintain two yard intervals while advancing..	2
8. Failure to test condition of roof.....	3
9. Failure to test for presence of gas.....	4
10. Failure of captain to give command.....	4
11. Failure of member of crew to obey command.....	5
12. For breathing external air intentionally.....	12
13. Failure to protect live men against mine gases.....	8
14. Failure to use life line in smoke.....	8
15. Failure to complete event in time specified.....	6
16. Losing time or doing unnecessary things.....	4
17. Failure of captain to examine gauges, apparatus, etc.....	2
18. Failure to mark course of travel.....	3
19. Failure of crew to rest at intervals.....	2

To men seeking employment: Unless you are willing to be careful to avoid injury to yourself and fellow-workmen do not ask for employment.

REQUIREMENTS OF MINE RESCUE WORK

1. Each crew will be required to walk 117 yards in two minutes and immediately enter smoke room and remain for four minutes.
2. Upon coming out of smoke room the pulse of each man shall be taken by a doctor. Such as have a pulse over 130 shall be given a discount, which will be charged against the crew.
3. The judges will ascertain the condition of each apparatus, its assembled parts and if properly fitted to the wearer.
4. The crew will proceed to perform the event which is assigned it.

Bulletin No. 32

Safety Series No. 9

Real
University of Arizona
Bulletin

CHARLES F. WILLIS, *Director*

State Safety News
August, 1916



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1916-17

.....1916

**J. T. MORE, Secretary,
SOUTHWESTERN MINE SAFETY ASSOCIATION,
Ray, Arizona.**

Enclosed please find ^{money} order for Three Dollars (\$3.00)
check
for membership in the Southwestern Mine Safety Association for
the year 1916.

Address.....

.....

State Safety News

Safety *Efficiency*

SAFETY SERIES No. 9

AUGUST 1, 1916

WHAT "SAFETY WORK" MEANS TO EVERY MAN

"And the end is that workmen shall live to enjoy the fruits of his labor; that his mother shall have the comfort of his arm in her old age; that his wife shall not be untimely a widow; that his children shall have a father, and that cripples and helpless wrecks who were once strong men shall not longer be a by-product of industry."—*National Safety Council.*

These are reasons enough for any man to work carefully.

Any one of those reasons ought to be enough. When you start to go through a narrow space which may be dangerous, or do a careless piece of work, think of the effect on people whom you care about.

One careless act on your part may bring great pain and sorrow to many people. *Think!*

They that do not understand cannot well explain.

MINE ACCIDENTS IN MONTANA

During the first three months the State Compensation Act had been in force in Montana, the number of accidents recorded was 1289, of which 20 were fatal. The total amount paid as benefits was \$24,865.00. Accidents in connection with the mining industry constituted 67 per cent. of the total. Of the fatal accidents, ten occurred at mines and five at smelting works. From the report of the commissioners it is learned that with a similar proportion of accidents throughout the year, twenty out of every one hundred men engaged in mining, and twelve out of every one hundred men employed in connection with smelting, will be injured; these figures compare with ten out of every one hundred working at lumbering and logging. As bearing on the question of compensation, it may be mentioned that local newspapers have quoted the Industrial Insurance Commission as having made an announcement as to the amount of money that will have to be paid out of the Washington State accident fund as a result of the disaster which occurred last month at the Ravensdale coal mine in this state. It is stated that a reserve

fund of \$70,778.83 will be necessary for payment of pensions to dependants of the twenty married workers who were killed. Eleven other victims of the explosion were unmarried, and, so far as known, have not left any dependants. It is probable that there will have to be made a special assessment on coal mine operators, there not being sufficient money in hand in the coal mining section of the fund to meet these obligations. Payments in connection with such a special assessment, however, will be credited as being part of the premiums that under ordinary conditions would have to be paid later.

Knowledge is power. It's the difference between the laborer and the "big boss".

Headquarters, 208 S. LaSalle St., Chicago, June 19, 1916.

Dear Fellow Members

A series of lectures was given in one of our leading engineering schools during the past winter. The lecturers were twenty engineers who have done efficient industrial and safety service in particular industries. The professor in charge of these lectures recently said:

"We are beginning to recognize the great importance of the human factor in industry. We want every engineering student who leaves this school and goes into our industrial plants to appreciate the fact that the training and conserving of the human equipment is one of the indispensable factors in making for efficiency."

This is one more indication of the coming of the new day in industry—the day of the new and greatest science—*Human Engineering!*

NATIONAL SAFETY COUNCIL,

W. H. Cameron, *Secretary.*

*If we but think, we will have care of our own
acts, care for the careless, and thought for
those who do not think.*

DRY EXPRESS BY THE DROP.

The following story was told the editor by a Virginian who dropped into our office the other day.

It seems that our visitor was in a little "dry" town in "Old Virginia", a few weeks ago, and happened to hear a conversation between the railroad station agent and a negro.

"Is they any express fo' me today?" asked the negro.

"Not a drop", said the humorously inclined agent.

UNAVOIDABLE ACCIDENTS

All accidents classified as unavoidable should be carefully investigated by the employer and the causes removed or provided against in so far as the business of industry will permit. The prevention of accidents should be the first consideration in all hazardous occupations. It saves money, saves time, prevents accidents, prevents suffering, improves conditions and creates higher industrial ideas. Safety both saves and pays and by effective mutual organization and cooperation changes can be brought about whereby "preventable injury losses" can be changed to profits, with all the other benefits that such a change implies.

Of course it cannot be claimed that accidents will not happen regardless of precaution. It is acknowledged that in spite of the best organizations and the most impressive admonitions, machinery will fail and human judgment be at fault. This is a deplorable fact, perhaps inseparable from our economic life. Nevertheless, accidents that result from carelessness, thoughtlessness, ignorance or absent mindedness, can and should be avoided. Mind wandering from the actual work that the employee is engaged in is probably one of the most fruitful sources of accidents. The workman who goes about his work as though he were in a trance is sure to come to grief.

Compensation laws and safety provisions are made for the workman. He is not expected to be a subjective beneficiary only, but an active agent, in forestalling these unfortunate happenings which necessitate compensation laws.

Every intelligent human being knows that nothing "just happens". Everything is the result of an efficient cause. So-called unavoidable accidents can be traced to a falling short in observation, experience or judgment in one form or another. Detailed investigation will nearly always show that if the unfortunate had given closer observation, or more attentive care to what he was doing and had exercised thoughtful caution and clear judgment, that the accident would not have occurred.

Employees with known caution and thoughtful carefulness are everywhere preferred to a reckless worker, who may bring disaster upon himself and expense to his employer, through lack of caution. Carefulness should become an object of intelligent appreciation and a part of the necessary equipment of an employee engaged in hazardous occupation.—*Report Montana Industrial Accident Board.*

He who cannot obey cannot command.

ASSAY OFFICE SAFETY

A piece of equipment has been designed by H. T. Murray, chemist for the Hayden plant of the American Smelting and Refining Company, that is worthy of the attention of all chemists and assayers. The down draft hood has been instrumental in practically eliminating the unpleasant and dangerous gases that are often encountered, particularly on rainy or damp days.

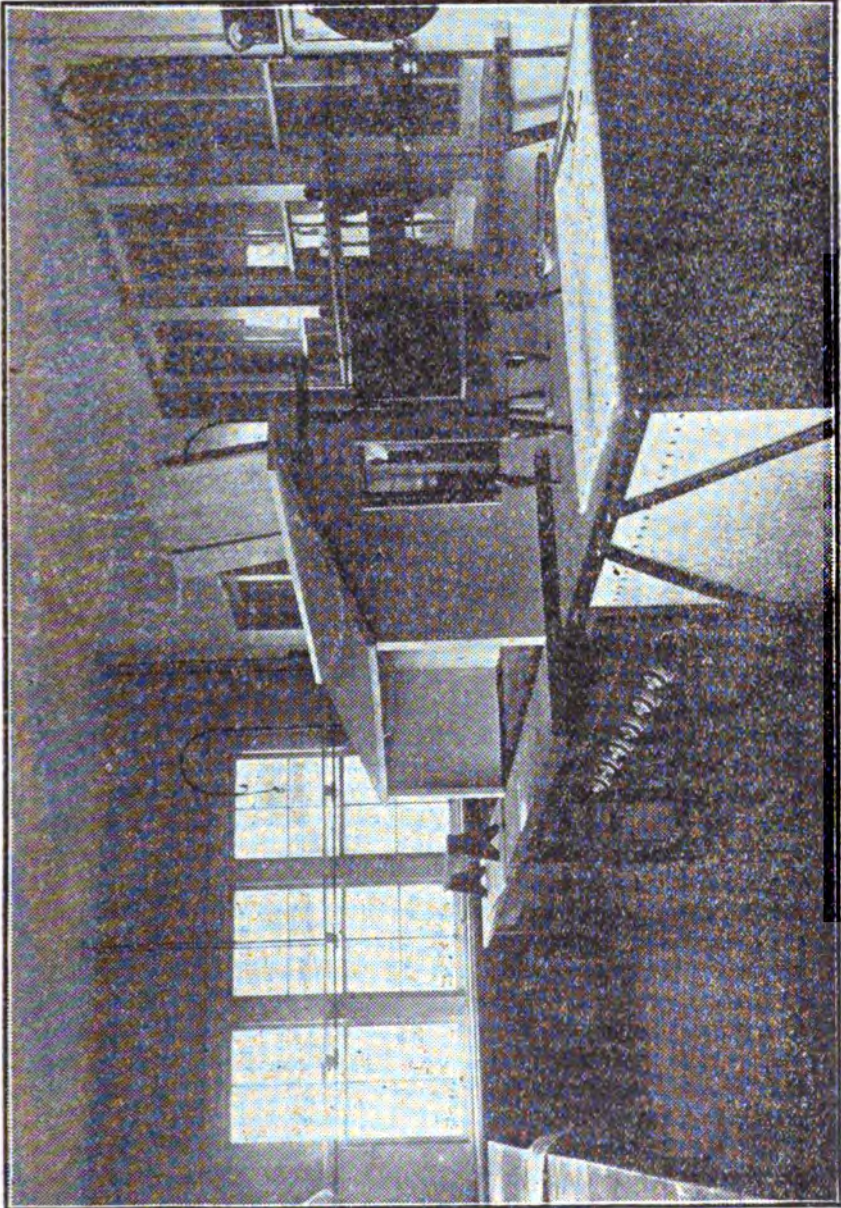
This hood, a cut of which is shown on the next page, has the cast iron shelf covered with $\frac{1}{4}$ inch asbestos lumber. The hoods are through a 10 inch galvanized iron to a direct connected exhaust fan, giving a draft of about 3 ounces. The draft will pull all fumes from even the front edge of the shelf. Blue prints of this hood will, we believe, be sent those interested, as Mr. Murray is much interested in the improvement of chemical laboratory conditions.

*Lost time is never found again, and what we
call time enough always proves little enough.*

THE NAIL AGAIN

To step on the point of a nail causes a direct loss of money. Somebody has to pay for the resulting injury, which is often a serious one. Unfortunately, the man who leaves the nail sticking up is seldom the one who steps on it. But in the long run, if A steps on the nail that B left, and B steps on C's nail, or C on A's, or otherwise around the circle of events, the situation is much the same as if every man that left a projecting nail point where somebody could step on it or catch on it was likely to suffer the injury himself. This is a clear argument for more care in dealing with projecting nails. Two concerns state that injuries from nails form 3 to 6 per cent of their total casualties, according to George Gilmore, Chief Engineer of the Travelers' Insurance Co. *The Travelers' Standard* in an article on the nail hazard points out further that clinching a nail may make it more dangerous than the straight projecting point, if the clinching is not thorough. A nail point bent over so that it is nearly flat on the surface of the board, but yet clear of it a few sixteenths of an inch, may catch the foot or the hand to worse effect than an unclinchd point, while at the same time it seems safe, thus inviting the accident.

*It takes a lot of effort on the part of a thought-
less man to master Safety First, but every day
adds to his value as a workman and a citizen.*



DOWN DRAFT HOOD USED IN HAYDEN PLANT, A. S. & R. CO.

ACCIDENT DETAILS

While many of the mines have signified their willingness and intention of sending the *State Safety News* accident reports for publication comparatively, a sufficient number have not yet been received to start them in the present issue. It is anticipated that next month will see the list fully complete. If reports of the previous month are in our hands by the 15th, it can then be published in the issue of the following month.

A truly skilled workman is skilled not only in performing his work but in avoiding accidents. By far the greater number of accidents is caused by momentary thoughtlessness or carelessness.

THE "VIVATOR" OXYGEN REVIVING APPARATUS.

It may be recalled that the American Commission on Resuscitation from Electric Shock, which was constituted by delegates from the American Medical Association, the National Electric Light Association, and the American Institute of Electrical Engineers, severely questioned the efficacy of some of the commercial devices that have been placed upon the market for the promotion of artificial respiration.

One of the defects of these devices to which the commission called attention is their automatic activity, and the ease with which inspiration is turned into expiration. As soon as the inspiratory blast meets an obstacle in the air passages it is automatically cut off and turned into expiration, and thus frequently no efficient inspirations are performed. The second harmful factor brought out by the Commission's experiments was the performance of expiration by suction. For the reasons stated, the Commission favored a type of apparatus in which the operation of inspiration should be under the control of the operator, and freedom from sucking action, expiration resulting from the natural recoil of the distended parts. Messrs. Siebe, Gorman and Company, Limited, of Westminster Bridge Road, S. E., the well-known makers of rescue appliances, have succeeded in producing, in the "Vivator" apparatus, a device in which these desiderata are kept clearly in view.

The apparatus consists of a special pump, which, on the down stroke delivers oxygen from an oxygen bag connected to an oxygen cylinder, into the inspiratory tube of a mask fastened or held tightly over the patient's nose and mouth.

Having completed the down stroke, and so forced oxygen into the patient's lungs, the pump on its return, or up stroke, not only sucks in a fresh supply of oxygen to be delivered on the next down stroke, but also opens a valve connected with the expiratory tube of the mask, thus allowing the expiratory recoil of the expanded chest and lungs of the patient free play. The valve remains open during the up stroke, and automatically closes when the stroke is completed. The piston of the pump then descends and delivers another supply of oxygen and so on.

In operation the patient is placed on his back, and the clothing loosened round the neck and chest. While pulling the tongue forward the mask is applied firmly over the mouth and nose, and fastened by a strap behind the head. There are two valves on the oxygen cylinder: (1) The main valve, which should be turned one complete revolution, and kept on while the apparatus is in use; (2) a fine reduction valve for controlling the admission of oxygen to the bag, which should be kept fairly full. The pump is worked at twenty to twenty-four strokes a minute for adults, and at about thirty to forty strokes a minute for children, the younger the child, the greater the frequency of stroke. The pump should be started immediately the mask is applied to the face. To prevent the gas from being driven into the stomach, pressure may be made with the thumb over the larynx (Adam's apple). By this means the gullet is driven against the backbone and shut up. The larynx itself is a stiff gristly structure, and resists compression, so that the entrance to the lungs remains open. The stroke of the pump can be adjusted to suit individuals of different sizes and ages. If the oxygen has been all used up, and recovery has not yet taken place, the operator should open the air valve and continue the respiration with air. If a new cylinder of oxygen can be obtained, this should be attached.

Messrs. Siebe, Gorman and Company also make the "Pulvita" resuscitating device, which is a simple oxygen inhaling apparatus, for use in cases where the Schafer or other methods of resuscitation can be used. It consists of a special rubber mask with inlet and outlet valves, a plain rubber bag of twenty litres capacity, an oxygen cylinder containing six cubic feet of oxygen, connecting tubes, pressure gauge, and pressure reducing valve. The "Vivox" resuscitating apparatus, on the other hand, is a combination oxygen inhaling apparatus, designed for use alternatively where the patient is brought into fresh air, or where he is confined in a place, such as a foul mine, where the surrounding atmosphere is irrespirable. This apparatus has two masks—one like that supplied with the "Pulvita" set, for use where

the patient is treated in fresh air; the other a mask of special design for strapping airtightly to the patient's head. This mask is fitted with inlet and outlet valves, the former connected to the oxygen bag, the latter allowing the patient's expired air to discharge into the atmosphere.—*Colliery Guardian*.

Stick to it steadily and you will see great effects. Constant dropping wears away stones.

LOSING A GROUCH

Perhaps you overslept a few moments this morning; perhaps you were out late last night; perhaps you lost your temper yesterday and the toxic poison then generated spoiled your night's rest; anyway, you started the day with a full-sized grouch.

You did not have time to shave and take your limbering-up exercise, so you cut out your morning breathing stunts. Your breakfast did you little good and you left the house feeling very dissatisfied with the good old world.

It is two blocks to the street car line and when you reached the corner the car was half a block away. You are persued by fate, but—Did you ever try this: Walk to the next corner and take the car there; or, better, walk two blocks. This, together with the distance to the car line will give you a chance to get the grouch-poison out of your system before you reach the office.

The office boy can tell you the athletic record for 100 yards—about a city block—can you approximate your time for the same distance? You are to dignified to run, even if your lung power is sufficient for the distance, so you walk. How do you walk? Erect, shoulders back, taking up the jar by using the muscles of the legs as springs? Or do you just walk?

You should be able to cover the block in 60 seconds. If you pay attention to your breathing you can cover the distance in twelve breaths; after a little practice, in six. That is, inhale for five or six steps and then exhale for the same distance. Soon you will be able to count ten steps for the intake and ten steps for the exhaust. This makes a game of walking. Try it. Your work will be a game all morning, and, better still, you will smile while you are hitting the hard spots.

Do this and the morning flirtation with My Lady Nicotine will be postponed till the luncheon hour. Not much use advocating exercise during the noon hour, although a walk around the block is a valuable addition to your preparedness program.

In the evening you should walk a mile before supper. If you live too far away to walk the entire distance from the office to your home, you can, at least, walk part way. Walk rapidly, but do not strain the body or the lungs—work up to it gradually. If you are really tired when you reach home, rest a few moments before starting your supper. Don't hurry over this meal. Afterwards, rest for a time before you take further exercise, either doing chores about the house or in the open air.

Rest again for a little while before retiring. Be careful not to lose your temper—this generates a poison which adversely affects your body.

Keep your temper; exercise enough to protect your health (10 minutes a day will do); keep the body clean inside and out, and live the Biblical span.

Check yourself up now and then and see just what you have done, or are willing to do, to prevent accidents to yourself and to help others from having accidents. Are you a careful man?

THE MAN WHO WINS

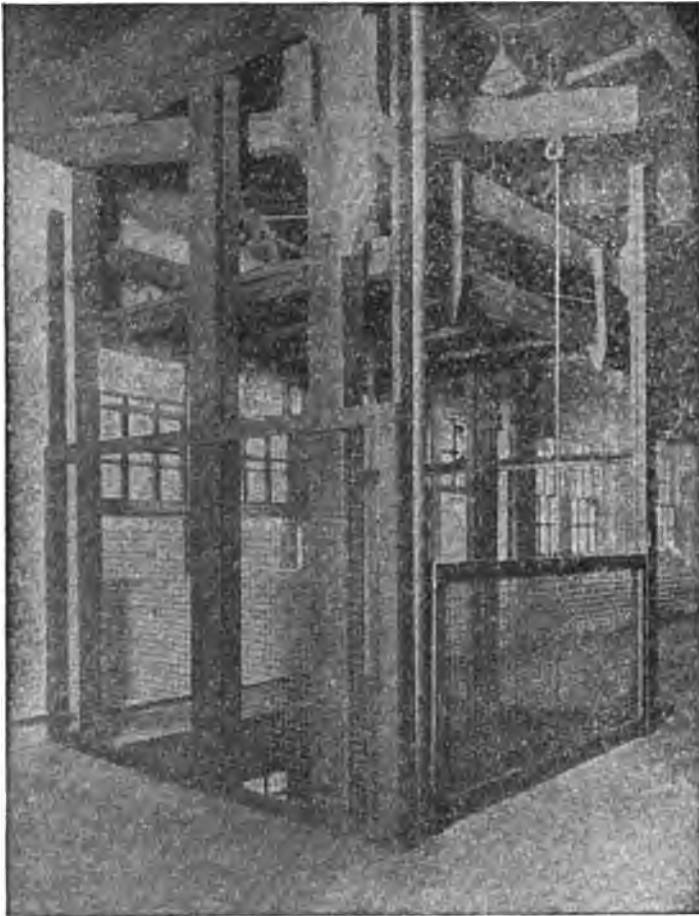
The man who wins is the average man,
Not built on any particular plan,
Not blessed with any particular luck,
Just steady and earnest, and full of pluck.
When asked a question he does not guess;
He answers the question, "No" or "Yes".
When set to a task that the rest can't do
He buckles down till he's put it through.
Three things he's learned: That the man who tries
Finds favor in his employer's eyes;
That it pays to know more than one thing well;
That it doesn't pay all he knows to tell.
For the man who wins is the man who works,
Who neither labor nor trouble shirks,
Who uses his hand, his head, his eyes,
The man who wins is the man who tries.

—*Detroit Free Press.*

*It is better to take pains to prevent an accident,
than to suffer pains as the result of one.*

INDUSTRIAL

The W. S. Tyler Company, of Cleveland, Ohio, has been conducting a "Safety Campaign" and pushing their own goods at the same



**Wood Frame Galvanized Wire Cloth Gate and Guards
Protecting Elevator Shaft**

time. All kinds and descriptions of guards can be cheaply made from wire cloth.

As shown in the illustration, the protecting guards can be made

by mounting the galvanized wire cloth on wooden or light metal frames. In order to make the guards the correct size to fit the particular machine, they can be built to much better advantage and fitted to the machine by a mechanic on the ground. The cheapest and most economical way to protect your machinery is to order the galvanized wire cloth and have the guards made up in your own plant by a carpenter or machinist, to fit each particular machine. The $1\frac{1}{4}$ inch opening .177 inch Tyler "Crimps Between" Netting galvanized after weaving is so stiff and firm that it only requires a very light wooden frame in order to make a firm and substantial guard. Where the heavier sizes of wire are used in making the guard, the wire cloth is firm enough to support the frame so that it is possible to make a very light guard which at the same time will be very strong.

The woven wire cloth guards admit air and light freely and leave the running parts of the machinery visible so that if anything gets out of order, it will be noticed at once by the operator. For this reason, they are much superior to a solid metal or wood covering.

Throw out a safety line to the men who overlook safe methods and gamble with life and limb. The safe man is—and always will be—the best man.

DON'TS FOR RESCUE CORPS.

1. Don't fail to notify the man in charge of apparatus at once in case of trouble.
2. Don't tamper with the apparatus. It is ready for service.
3. Don't use old batteries in your lamp.
4. Don't hurry when using the apparatus.
5. Don't put the apparatus on alone and go into the danger zone without having someone make a thorough inspection of the apparatus. Don't go into the danger zone alone.
6. Don't use old cartridges in dangerous work.
7. Don't fail to look at pressure gauge before going into the danger zone.
8. Don't fail to connect all connections before putting the apparatus on.
9. Don't fail to keep in communication with the other helmet men.
10. Don't take helmet off in danger zone.
11. Don't forget that the rescue of men is the first consideration.
12. Don't forget to send for the first aid immediately.
13. Don't chew tobacco in the helmet.

14. Don't disturb too much wreckage on the first inspection. It might start something.
15. Don't fail to note conditions.
16. Don't fail to report conditions noted.
17. Don't fail to report any abnormal behavior of the apparatus.
18. Don't fail to return immediately if you think that the apparatus is not working properly.
19. Don't take any chances. **PLAY SAFE.**
20. Don't fail to follow instructions.
21. Don't go into a strange mine without a guide.
22. Don't expect to be able to work as hard or as fast with the apparatus on as without it. You are carrying a load.
23. Don't, under any circumstances, when exploring a mine in which electricity is used, get in contact with bare wires, unless you are sure the current is cut off.
24. Don't fail to take extra electric lamps with you from the rescue station. Some may not work properly.
25. Don't forget the apparatus is good for only two hours.

Do not go into dangerous places until you are absolutely sure they are safeguarded; also prevent anyone from going until this is shown to be a fact.

Bulletin No. 33



Safety Series No. 10

22

University of Arizona Bulletin

CHARLES F. WILLIS, *Director*

State Safety News
September, 1916



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TUCSON, ARIZONA**

1916-17

.....1916

J. T. MORE, Secretary,
SOUTHWESTERN MINE SAFETY ASSOCIATION,
Ray, Arizona.

Enclosed please find ^{money}~~check~~ order for Three Dollars (\$3.00)
for membership in the Southwestern Mine Safety Association for
the year 1916.

Address.....

.....

State Safety News

Safety

Efficiency

SAFETY SERIES No. 10

SEPTEMBER 1, 1916

THIRD ANNUAL MINE RESCUE AND FIRST AID CONTEST

Notification has been sent to the companies operating within the State of the Third Annual Mine Rescue and First Aid Contest. There has been some dispute as to where this contest shall be held, and it was finally decided that it should be held at Phoenix, during the week of the State Fair in November.

The first contest held two years ago was during the State Fair, and the second, Labor Day, 1915, in Bisbee. Both of these were very successful particularly in view of the fact that at the Phoenix exhibition little was really understood of the Safety First movement.

The Safety First movement has expanded so rapidly that it is now much more thoroughly understood and a successful contest before the large number of people in Phoenix during Fair week means much for the strengthening of the Safety movement. To have this successful contest, there must be representation in teams from every district and every mine maintaining a team in the state.

At the first annual contest but few companies were represented. An improvement was made at the Bisbee meeting, and this year should see every mine in the state represented. There is probably no better time than the present to demonstrate to the people of the state the interest of the mine operators in the Safety movement. The demonstration at Phoenix will be before not only the mining public but the general public as well, the farmers, the cattlemen, and others who have just as much to say in the making of our laws as the miner, and far more to say than the mine operator.

The farmer and the cattleman regard the mining industry as one that takes its annual toll of human life. It is considered a part of the price paid, a part of the risk taken, and they do not fully understand that every possible effort is being made by the operators to reduce this risk, and to make the living and working conditions as safe and as healthful as on the farm.

This being a year of prosperity in the mining industry, and a year of politics in the state, makes no better time to have a large and

thorough demonstration of the interest of the operators in the creation of safe conditions.

Mr. J. T. More, the Secretary of the Southwestern Mine Safety Association, has worked hard for the success of the contest, as well as G. W. Salisbury, Chairman of the Committee on First Aid and Contests. Those desiring to enter should communicate with these gentlemen.

While we are on the subject, why not carry this demonstration of Safety farther? Why not carry in the mining building of the State Fair exhibits to show to the people what the companies are doing in their safety and welfare work? An exhibit could be maintained under the auspices of the Southwestern Mine Safety Association, and I believe it would be very much to the advantage of the operators.

Think it over and tell the other fellow what you think about it, or let us tell him.

Better be careful than crippled.

BOOZE OR WORK.

You would think a man foolish, if he climbed into a tree, and sawed off a branch between himself and the tree. You would say he was foolish or crazy, because he was certain to get a bad fall.

How about the man who has a good job, and cuts himself off from it by drinking? Is he less foolish than the man in the tree?

Experience has proved beyond any doubt that booze and good work cannot go together. When booze interferes with business, it generally cuts out the business.

Skilled workmen lose their skill through liquor. Alcohol numbs the brain and nerves, and the workmen who indulge in liquor are dangerous to themselves and their fellow workmen.

Can you name a case where booze got a man a better job, better pay, brought happiness into the home, or made life more worth while?

It can't be done! The man who cares anything about his job, and expects to get ahead, will keep away from liquor.

Your body is a big part of your capital. Don't invest it in the "Bank of Careless Habits."

ARIZONA COPPER CO., LTD.

J. R. Shanley, who succeeded L. M. Banks as safety inspector of the Arizona Copper Company, is publishing very neat bulletins rela-

tive to their safety work. The circulars are published in both English and Spanish. Many of these contain new and good ideas—one is published below so you may see for yourself.

“THE NEW AND THE OLD.

“Is Safety First a passing fad that is here today and gone tomorrow?

“Apparently some of the old timers think so.

“Let me tell the old timers that they are wrong.

“You ‘old timers’ have learned your hard lessons in the school of experience. You ‘old timers’ are splendid fellows, you can show your records of past performances and can still hold your own with the best of ‘em.

“But the ‘new man’ has yet to learn and must be protected when he is learning. He must be shown how to safeguard himself and it’s up to the Safety movement and you ‘old timers’ to show him.

“‘Old’ and ‘new’ timers must realize that mining conditions are changing all the time. A few years ago a miner broke and one mucker shoveled enough ore in a shift to make a ton of copper. Nowadays it takes three machines, three miners, and nine muckers to get the same ton of copper. Some difference, eh?

“We used to mine less than one thousand tons per day; now we are mining more than three thousand tons.

“These changes all mean new methods, more men and different conditions. There is more hurry and rush today in all concerns. A man has to do his work now in eight hours where formerly he took ten and even twelve.

“One result of these changes was a serious increase in the number of accidents. This was felt not only in mining but in all industries. The necessity for greater safety was so vital that the whole industrial world has joined in the Safety First movement. The great principle underlying the Safety First movement is the fact that the majority of accidents are preventable. You ‘old timers’ know it; you ‘new timers’ are learning it. Join the Safety First movement, new and old timers; you will never regret it. Safety First has come to stay because people now realize the folly of needless pain and suffering caused by avoidable accidents.

“‘Old Timers’, ‘New Timers’, protect yourselves and your fellow workmen from avoidable accidents.”

*There are just two kinds of people on earth.
The people who lift and the people who lean.
Which are you?*

STIMULATION OF SHIFT BOSSES

In order to stimulate the shift bosses with such zeal and close attention in their safety supervision as would be expected in the attitude of a kindergarten teacher toward her pupil, the New Jersey Zinc Co., at Franklin Furnace, N. J., offered a prize of \$200 at the end of the year to the mine shift boss or timber boss having the best record for freedom from serious accidents, whose value was rated by the company's doctor in accordance with his prognosis rated against the total shifts of labor supervised by that boss. A table of prognosis values was formulated with due regard to the relative values of fatalities, total disabilities and major injuries as shown in the New Jersey employers' liability and compensation laws, and the probable length of time of disability was considered in setting values for minor injuries. The following table is a list of injuries and the values applying to them, among which is a demerit of 50 points for the failure of a boss to report an accident.

VALUATION OF INJURIES FOR SAFETY WORK

<i>Diagnosis</i>	<i>Length of Disability</i>	<i>Numerical Basis</i>
Loss of life.....		200
Total disability.....		200
(a) Loss of both eyes		
(b) Loss of both arms		
(c) Loss of both legs		
(d) Broken back		
Loss of arm or leg.....		150
Loss of eye.....		125
Fracture of femur.....	3 months	100
Compound fracture of arm or leg.....	3 months	100
Loss of thumb or big toe.....		75
Simple fracture of arm or leg.....	2 months	60
Loss of fingers or toes.....		50
Injuries of joints.....	1-4 weeks	7-30
Lacerated wounds.....	1-3 weeks	7-30
Contusions.....	1-2 weeks	7-15
Abrasions.....	1-10 days	1-10
Scalp wounds.....	1-10 days	1-10
Dislocations.....	2 weeks	15
Failure to report accident.....		50

Although we realized that chance played an important part in the winning of this prize, inasmuch as many accidents have the same poten-

tialities but result in sometimes trivial and sometimes serious injuries, nevertheless, in view of the fact that the failure of a boss to win reward did not deprive him of anything which he had previously enjoyed, it seemed that such a prize would prove a stimulus to devote attention to safety work so as to improve their chances of winning. It was gratifying to note that this prize went to a man whose work lay in a comparatively hazardous territory, so far as treacherous ground was concerned, and also fell to a man who was conspicuous in his interest and precautions for safety.

*A fire department without firemen is just like
safety devices without safe and careful
operators.*

DIRECTIONS FOR RESTORING THE APPARENTLY DEAD

If from Drowning, Suffocation or Narcotic Poisoning—Send for medical assistance, blankets and dry clothing, but proceed to treat the patient *instantly*.

The points to be aimed at are:—First, and immediately, the *restoration of breathing*; and secondly, after breathing is restored, the *promotion of warmth and circulation*.

The efforts to restore life must be persevered in until the arrival of medical assistance, or until the pulse and breathing have ceased for an hour.

Professor E. A. Schafer's Method—Immediately after removal from the water, lay the patient face downward with the arms extended. Turn the face to the side. Kneel astride or on one side of the patient. Place the hands on the small of the patient's back, one on each side, with the thumbs parallel and nearly touching. Bend forward with the arms straight so as to allow the weight of the operator to bear on his wrists, and thus make a steady, firm downward pressure on the lower part of the patient's back, (the loins and lowest ribs.) This part of the operation should occupy the time necessary to count slowly, one, two, three.

Immediately after making the downward pressure, the operator should swing backwards so as to relax the pressure, but without lifting his hands from the patient's body. This part of the operation should occupy the time necessary to count slowly, one, two.

Repeat the forward and backward movements—that is, the pressure and relaxation of pressure—without any marked pause between the movements. The downward pressure forces the air out of the lungs

and the relaxation of pressure causes the air to be drawn in again. Continue the movements at the rate of about twelve per minute, until natural breathing has recommenced. When natural breathing has fairly begun, cease the movements. Watch the patient closely, and, if natural breathing ceases, repeat movements as before.

Treatment after natural breathing has been restored—To induce circulation and warmth. Wrap the patient in dry blankets, and rub the limbs upwards energetically. Promote the warmth of the body by hot flannels, bottles or bladders of hot water, heated bricks to the pit of the stomach, the armpits, and to the soles of the feet.

On the restoration of life, when the power of swallowing has returned, a teaspoonful of warm water, small quantities of wine, warm brandy and water, or coffee should be given. The patient should be kept in bed, and a disposition to sleep encouraged. During reaction large mustard plasters to the chest and below the shoulders will greatly relieve the distressed breathing.

Note—In all cases of prolonged immersion in cold water, when the breathing continues, a warm bath should be employed to restore the temperature.

If from Intense Cold—Rub the body with snow, ice or cold water. Restore warmth by slow degrees. It is highly dangerous to apply heat too early.

If from Intoxication—Lay the individual on his side on a bed with his head raised. The patient should be induced to vomit. Stimulants should be avoided.

If from Apoplexy or from Sun Stroke—Cold should be applied to the head, which should be kept well raised. Clothing removed from neck and chest. Stimulants avoided.

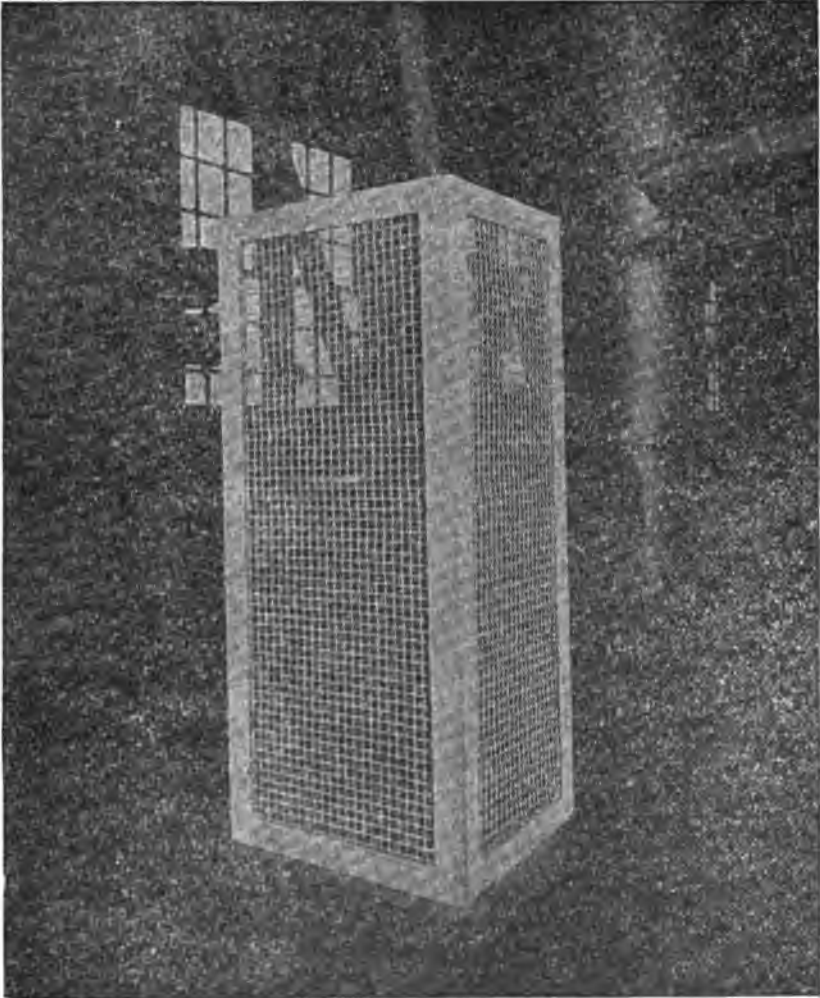
If from Electric Shock—Remove the body from contact with the wire, cable or other conductor (in doing this the body must not be touched with the naked hand, but india rubber gloves, a fold of dry cloth or other non-conductor should be used) and at once proceed to induce respiration by the above method.

Appearances which generally indicate death—There is no breathing or heart action; the eyelids are generally half-closed; the pupils dilated; the jaws clenched; the fingers semi-contracted; the tongue appearing between the teeth, and the mouth and nostrils are covered with a frothy mucus. Coldness and pallor of surface increases.

The prevention of accidents and injuries, by all possible means, is a personal duty which everyone owes, not to himself alone, but also to his fellow workmen.

INDUSTRIAL

Just another suggestion from the Taylor Wire Screen Company as to how wire screening may be used to promote safety. See cut below.



**Wood Frame Galvanized Wire Cloth Guard
Protecting Belt on Blower**

THE TREADWELL MINE

Safety work has now won a firm hold on the intelligent managements of mines. The main feature has been the effort to arouse the interest and co-operation of the miners themselves. This has been done at the Treadwell group of mines, for example, by organizing a Committee of fifteen, eight of whom are appointed by the Labor Union and seven by the Mine Management. This committee is divided into five sub-committees, covering as many mine departments, so that when an accident occurs the fact is reported to the foreman, mine superintendent, and the sub-committee of that department. These make a prompt investigation and deliver a written report on the causes and consequences of the accident to the main Committee of Safety. In making reports, it is understood that the facts and comments shall be stated honestly and fearlessly, as thus only is it possible to secure evidence of value for future emergencies. The members of the Committee are paid by the management for the time they devote to this work which throughout is placed on a workmanlike basis. A cash prize of \$25 is paid quarterly by the Treadwell company to the employee who submits the best suggestion for preventing accidents in or about the mines. Some good ideas have been elicited in this way, and the general interest of the men has been stimulated thereby. First Aid lectures are given by the company physician once a week and the men are taught the proper use of restoratives and remedies. The whole scheme has been admirably considered and elaborated.

Personal caution is the best preventative of accidents.

INDIVIDUAL BULLETIN SERVICE—TAKING THE BULLETIN BOARD TO THE MAN

The Eastman Kodak Company is using an individual bulletin service which promises excellent results. A small holder is provided for each work place or machine and a card about $2\frac{1}{4} \times 3\frac{1}{4}$ containing the safety lesson of the day is placed in the holder before starting time each day.

The bulletin cards vary in color and number a score or more—each presenting a complete thought along safety lines. Shop hazards are clearly dealt with, and street accidents, home suggestions and special bulletins are presented in graphic form.

"Go Carefully Around Corners", says one of these miniature bulletins; "Live Switches—Pull Them Both if You Are in Doubt", "Track

Walking", "Waste", "Skylarking" and many other titles suggest the splendid possibilities of the scheme. The cards are changed every day. The sample cards show a month's supply, each card shifting ahead one place every day. The cost is insignificant compared to the value of the idea. The lesson is valuable and obvious in its presentation while the plan insures an intimate relation between employer and employee.

Write for sample copies of the cards if you wish them.

*Life's battles don't always go to the stronger
or faster man.*

SAFETY FIRST—PREPARE DEFENSE FOR YOUR EARS.

The necessity of ear protection in every walk of life is becoming more evident as this noisy age progresses. The disastrous results of detonation from gunfire and other loud noise have demonstrated beyond a doubt that the armies and navies of the world must in the near future be supplied with defense for the ears. The estimated expense of educating an officer for the service amounts to thousands of dollars. The concussion from a single gun volley or bursting shell may destroy the hearing, thereby disqualifying both officers and privates for life. Government medical statistics show about three hundred men are annually incapacitated in the United States Army and Navy service, largely on account of ear trouble, mostly due directly or indirectly to gunfire.

When the expense of disability is considered, the cost of ear protection is infinitesimal.

Defective hearing is on the increase, partly, no doubt, due to the prevailing disregard of the excessive noises of the present age. The



delicate ear structures become less sensitive to the more moderate touches of sound when they have been exposed to repeated pounding of such noises as gun reports, fog horns and the rattle of cars, subway trains, machinery, etc. Beginning with such slight impairment of function the condition gradually progresses, according to the duration and severity of the vibration. An ear may respond to a sound, yet not record either

the quality or variations of intensity. Then it can no longer transmit normally the vocal sounds of ordinary conversation, nor any other moderate vibrations, such as musical tones, etc.

Of equal importance to a thoughtful person is the effect of several noises upon the brain and nervous system, the excessive impulse being transmitted through the ear apparatus and auditory nerve to the brain. That severe noise, shock by shock, wears away much of the energy of the nervous system cannot be denied. Train noises, gun reports, the clash of machinery, etc., produce headache, dizziness, ringing in the ear, and other mental and nervous symptoms.

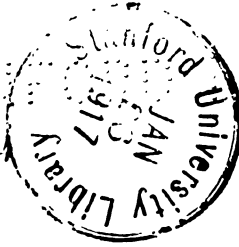
There are many different ear protectors on the market. The Elliott Perfect Ear Protector, as illustrated herewith, was awarded the gold medal and diploma at the Third National Exposition of Safety and Sanitation of 1916, held under auspices of the American Museum of Safety. Further information regarding this may be obtained from J. A. R. Elliott, Box 201, New York City.

*A pessimist is one who sees microbes in the
milk of human kindness.*

STATE LIBRARY

Bulletin No. 34

Safety Series No. 11



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University of Arizona Bulletin

State Safety News
October, 1916



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CHARLES F. WILLIS, *Director*

TUCSON, ARIZONA

1916-17

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.....1916

**J. T. MORE, Secretary,
SOUTHWESTERN MINE SAFETY ASSOCIATION,
Ray, Arizona.**

Enclosed please find ^{money} order for Three Dollars (\$3.00)
check
for membership in the Southwestern Mine Safety Association for
the year 1916.

Address.....
.....

State Safety News

Safety

Efficiency

SAFETY SERIES No. 11

OCTOBER 3, 1916

The dates of the Phoenix Contest are as follows: Tuesday, November 14, Mine Rescue Contest, 9:00 a. m.; First Aid Contest, 1:00 p. m. Contests to be held near the Main Entrance, close to the Mineral Building.



HERE is little doubt of the success of the Mine Rescue and First Aid Contest to be held at the State Fair in November as it is probable that there will be eight First Aid and four Mine Rescue teams compete for the state championship. It is likely that the contest will be held on consecutive mornings, for at that time nothing else is scheduled, and there should be nothing to divert the attention of the crowd. In the afternoon the automobile, horse races, etc., are staged, and it would be difficult to have these contests command the proper attention.

The question has been raised as to what kind of judges are to be furnished, practical or theoretical. It is probable that the United States Bureau of Mines will furnish at least a nucleus of the judging staff. The men in the employ of this Bureau have been engaged to carry on actual, practical work in First Aid contests and are undoubtedly fully qualified to do so. It is probable that there will be two or three men from the U. S. Bureau, with local talent filling out the balance of the judging staff.

Any suggestions as to the carrying out of these contests will be gratefully received by J. T. More, Secretary of the Southwestern Mine Safety Association, Ray Arizona.

SAFETY RESEARCH

A Safety Engineer of Philadelphia, speaking of the progress of accident prevention, referred to the improvements that had been made "since the time when Noah put a toe board around the poop deck of the Ark, and warned Shem not to let his feet hang over when he was fishing."

Can anyone go further back than this in "Safety First" research?—Safety Engineering.

THE SAFETY FIRST MOVEMENT

BY FORBES LINDSAY

It is characteristic of our people to disregard evils long after they have passed the point where the leading European nations would demand reform. It is equally characteristic of us to act energetically and thoroughly when once we are moved. Thus, the American public has submitted with indifference to enormous and largely unnecessary loss of life and infliction of injury to our industries, railroad operation and other activities, but a sudden awakening has resulted in a preventative movement which bids fair to outdo the precautionary measures that have been successfully enforced in Great Britain and Germany for many years.

The credit for arousing public sentiment and adopting safeguards must be given to certain corporations, among which Accident Insurance companies have been prominent. They were followed by municipalities, states and, finally, by the Federal Government.

Early in this year two great expositions of Safety and Sanitation were held—one in New York and the other in the City of Washington—with the object of demonstrating how citizens should be prepared against accident, disease and other influences that endanger life and health. Following these exhibitions, which were of the most practical character, the Secretary of the Interior conceived the idea of extending their educational advantages to the population of the central states. The Baltimore and Ohio Railroad Company generously offered to furnish the necessary train and equipment at a cost of \$250,000.

The Safety First Train is composed of twelve cars, nine of which are devoted to the exhibits of the various bureaus, the other three being occupied by the Government representatives and caretakers.

The Interior Department is represented on this train by two cars. An entire car is devoted to the Bureau of Mines exhibit and is in charge of George W. Riggs, with John Morey as assistant. This car contains a complete representation of the rescue apparatus used by the Bureau of Mines, including a full set of the oxygen mine-rescue apparatus, a rescue telephone, safety lamps, oxygen resuscitators and a graphic illustration of the work of First Aid to the injured. The car is attracting much favorable attention and especially in the mining regions visited. The second car of the Interior Department contains the exhibits of the National Parks Service and the Reclamation Service.

The Treasury Department is represented by a car devoted to the Public Health Service and practically another car to the Coast Guard Service. The Public Health Service Car contains a dramatic representation of rural sanitation and is of especial interest in the country districts, as it deals with the difficult problems of pure water supply and proper sanitation in these districts. The Coast Guard Service is showing a full size surf power life boat and also the famous breeches buoy. Both of these exhibits attract unusual attention in the inland towns where nothing of this character has ever before been seen.

Sharing part of the car containing the exhibits of the Coast Guard Service is the American Red Cross in charge of Dr. M. J. Shields. This exhibit contains illustrations of the methods being used by the Red Cross in teaching First Aid to the Injured to workmen throughout the country.

The Department of Agriculture is represented by the Weather Bureau, the Forest Service, and the Bureau of Animal Industry. The feature of the Weather Bureau exhibit is a mammoth weather map which is being made up each day, giving the people an accurate idea of weather conditions prevailing in all parts of the United States at that time. The Forest Service has a rather instructive illustration of the effects of deforesting the watersheds. The model contains two miniature mountains, one covered with evergreen growth and the other barren. By an ingenious arrangement water is turned on both of these mountains to represent rainfall, with the result that on the deforested mountain there is constant erosion of the soil and flood conditions in the valley below, while on the forested area the rainfall is held and trickles down into the valley in a lazy stream of clean water with no flood effects.

The Navy Department is represented by a car containing various exhibits that tend to quicken the patriotic pulse of the people. The showing of a machine gun, a white-head torpedo, a six-pound gun used as a defense against submarine and other similar devices of warfare are giving the people some idea of how the United States attempts to keep up its preparedness against attack. The Navy Department has a motto in this car which reads: "Preparedness is Safety First." The Navy exhibit also has a portable wireless apparatus used on submarines which is in use at each stopping place. The operators each day pick up the big news of the world from the Arlington wireless station.

The War Department is represented by its Medical Corps and also by the Corps of Engineers. Much interest is being manifested

in the display of gas masks being used in the European war as a preventative against gas poisoning and also a device used by the War Department which immediately turns box cars of a freight train into a hospital train; also a portable water purifying apparatus such as is being used by the troops in Mexico. The Engineers Corps of the United States Army is showing the equipment used in building trenches and bridges and also the equipment necessary for demolishing bridges.

An entire car is devoted to the work of the Safety Division of the Interstate Commerce Commission. In this car are found a model of the block signal system in operation, types of defective steel rails, the standard couplers for cars that have resulted in a big decrease in the death rate among trainmen, working models of passenger engines and material whose failure has led to disastrous accidents on the railroads.

The train has been out several weeks and has been an enthusiastic success everywhere it has appeared. The crowds are limited only to the capacity of the train to care for them. It has been estimated that not more than 1000 persons can go through the train each hour at a reasonable speed and see the exhibits. The attendance each week is about 50,000 people. It is expected that the train will visit more than 100 towns and cities on the Baltimore and Ohio Railroad system. There are many requests from other parts of the country to see the train and certain requests from other railroads. The question of taking the train over other railroad systems will be taken up later.

SUGGESTION

Don't monkey with the Buzz-Saw! Learn to do your own work, do it well and avoid accidents. Curiosity, intelligently directed is an entering wedge to greater knowledge; but when inspired simply by a desire to "meddle" it means trouble.

SOME QUEER ACCIDENTS

But Equally Odd Ways of Getting Injured Happen Daily

The following "queer" accidents were reported in the newspapers within a week. As odd a collection can be found any day in the year.

A steamer captain after years of adventures among the storms of the Great Lakes, was scratched on the arm by a pet kitten and died

a few days later of blood poisoning. A man on a bicycle speeding away from a snapping dog ran headon into a horse and wagon and was taken to a hospital badly broken up. A young man washed his sweater in gasoline when he went to bed, thought it was dry when he put it on in the morning, lit a cigarette and the sweater caught fire causing burns so severe that his life was endangered.

Other Surprising Accidents

Another man reading by the light of a lamp, detected gas odor, proceeded to look for leak, found he couldn't move his legs, had just strength enough left to throw some books at the door before becoming unconscious and was rescued just in time; lover under tree in park proceeded to kiss his sweetheart, fail to clear the brim of her hat, tore an eyelid off and nearly lost an eye; man reaching up to lift hat from hook, sneezed, shoulder slipped out, bad dislocation; man dreamt his arm had been cut off, walked through a lumber yard, fell on a saw and lost his arm; man looked out single track street car window when car was passing loop, car passing other way cleared the other by only a few inches, close enough to strike his head and tear it off his shoulders.—*Casualty Review*.

Fish in Kansas Shoots Angler

This is a true story of a fish that shot a man. Take it or leave it, just as you like: Richard O'Neil, 25 years old, is suffering from severe wounds at his home near here as the result of an unusual accident. O'Neil was fishing and had a small rifle with him. He had fastened his fishing pole to a stake in the bank and was loading his rifle when a fish caught the hook and pulled the line rapidly through the reel. In some way the line became tangled in the gun and discharged it, sending a bullet into O'Neil's leg.—*Los Angeles Times*.

Angler Is Pulled from Boat and Drowned by Fish

A fish yesterday drowned Halver Bakkan of Dallas, Wis., when he was fishing for muskellunge near Haugen, Wis., in Bear Lake. John Lystle, who was with him when the boat capsized, managed to save himself by hanging to the overturned boat.

It is thought that Bakkan was dragged to the bottom by his fish, which tangled its line about Bakkan's body, for after the boat capsized the fisherman did not come to the surface again.—*Los Angeles Herald*.

BE CAREFUL

The labor of those who labor to escape labor is the most laborious labor. In this same vein, there are those who are so anxious to be anxious that they go out of their way to meet anxiety. If those who labor to be anxious would labor as laboriously to be careful they could annihilate unnecessary anxiety. Affected anxiety is not calculated to cultivate carefulness. To convert care into carefulness try to be careful. If you can't be careful, be as careful as you can.

SAFETY ENGINEERS

Several inquiries have reached the Bureau of Mines with regard to the number of persons following the profession of Safety Engineering, and as no information was available in regard to this matter the Bureau of Mines has gone to considerable trouble to secure the names and addresses of men who are following the profession of Safety Engineering. A list which has been compiled is very likely incomplete, but it is thought to contain the names of more prominent representatives of the new profession.

The Bureau of Mines list is as follows: E. E. Bain, Ellsworth Collieries Co., Ellsworth, Penna.; A. A. Bawden, Pickands, Mather & Co., Hurley, Wis.; James Boston, Superior Coal Co., Gillespie, Ill.; C. M. Brading, Wisconsin Steel Co., Chicago, Ill.; F. E. Calkins, The Detroit Copper Mining Co., Morenci, Ariz.; P. A. Carmichael, Arthur Iron Mining Co., Hibbing, Minn.; J. J. Carrigan, Anaconda Copper Mining Co., Butte, Mont.; H. L. Chamberlin, Quincy Mining Co., Hancock, Mich.; Vernon P. Chappel, Iron Mountain, Mich.; D. E. Charlton, Oliver Iron Mining Co., Virginia, Minn.; Walter E. Chick, Pennsylvania Steel Co., Steelton, Pa.; F. E. Clough, Homestake Hospital, Lead, S. Dak.; William Connibear, Cleveland Cliffs Iron Co., Ishpeming, Mich.; A. W. Dennison, Black Hawk Coal Co., Black Hawk, Utah; Dr. F. C. Diver, Stag Canon Fuel Co., Dawson, New Mexico; W. H. Droll, Steptoe Valley Smelting & Mining Co., McGill, Nev.; J. B. Duff, Algoma Steel Corporation, Ltd., Sault Ste Marie, Canada; John Dunlop, 414 Columbia Terrace, Peoria, Ill.; F. E. Estes, Standard Coal Co., Standardville, Utah; Walter H. Finley, The Consolidation Coal Co., Fair-

mont, W. Va.; W. W. Fleming, Republic Iron & Steel Co., Republic, Pa.; Geo. T. Fonda, Bethlehem Steel Co., S. Bethlehem, Pa.; J. J. Forbes, Provident Coal Co., St. Clairsville, O.; M. W. Alexander, General Electric Co., West Lynn, Mass.; Thos. Gibson, Union Pacific Coal Co., Rock Springs, Wyo.; William T. Graven, Springhill, N. S., Canada; George W. Grove, 705 Fidelity Building, Duluth, Minn.; John W. Groves, Tennessee Coal, Iron & R. R. Co., Birmingham, Ala.; Dr. B. C. Guldin, Minersville, Pa.; J. S. Herbert, Cambria Steel Co., Johnstown, Pa.; C. A. Horning, O'Gara Coal Co., Harrisburg, Ill.; Leonard C. Jones, 104 Insurance Exchange Building, Sacramento, Calif.; Austin King, Fricke Coke Co., Scottsdale, Penna.; Charles Krallman, Peabody Coal Co., Glen Carbon, Ill.; D. Kranichfield, National Association of Manufacturers, Springfield, Ill.; H. L. Lack, Johnson & Johnson, New Brunswick, N. J.; C. E. McDermid, Utah Fuel Co., Winter Quarters, Utah; Charles C. McDougall, Athens, O.; Wallace E. McKeehan, Copper Queen Cons. Mining Co., Bisbee, Ariz.; Arthur Marsh, Box 197, Magna, Utah; George Martison, Gilbert, Minn.; Dr. J. M. Maurer, Shamokin, Pa.; R. K. Mead, Sagamore, Pa.; John J. Meacham, Mazon-town, Pa.; James L. Mills, Illinois Steel Co., Chicago, Ill.; H. E. Mitchell, Box Z, Eveleth, Minn.; Dr. F. F. Moore, Lucerne Mines, Homer City, Pa.; John E. Morgan, Northwestern Improvement Co., Roslyn, Wash.; W. H. Cameron, Continental & Commercial Bank Building, Chicago, Ill.; Hollis W. Overpecke, Oliver Mining Co., Virginia, Minn.; Henry R. Owens, Lehigh Wilkes-Barre Coal Co., Wilkes-Barre, Pa.; Duek Peckitt, Empire Steel & Iron Co., Wharton, N. J.; Sim C. Reynolds, Aetna Life Insurance Co., Houston, Pa.; George Roberts, Lucerne Mines, Indiana, Penna.; T. A. Schmidt, Morris Run Coal Mining Co., Morris Run, Penna.; L. A. Shoudy, Bethlehem Steel Co., South Bethlehem, Pa.; H. B. Smith, Illinois Steel Co., Joliet, Ill.; J. G. Smith, Inland Steel Co., Indian Harbor, Ind.; John W. Snow, Jr., Republic Iron & Steel Co., Palos, Ala.; Allen S. Snyder, Berwind-White Coal Mining Co., Windber, Pa.; B. M. Starnes, Sloss Sheffield Steel & Iron Co., Birmingham, Ala.; William A. Stevens, Glen Lyon, Luzerne, Pa.; C. S. Stevenson, Cleveland Cliffs Iron Co., Ishpeming, Mich.; J. Henry Williams, Cleveland Cliffs Iron Co., Ishpeming, Mich.; W. W. Williams, National Assoc. Manufacturers, Springfield, Ill.; J. M. Woltz, The Youngstown Sheet & Tube Co., Youngstown, O.; W. Zuendorff, The Consolidation Coal Co., West Van Lear, Ky.; J. R. Shamley, Arizona Copper Co., Clifton, Arizona; G. W. Salisbury, Jerome Victor Mining Co., Jerome, Arizona; R. J. Miller, United Verde Copper

Co., Jerome, Arizona; Thos. Cowperthwaite, Calumet & Arizona Mining Co., Warren, Arizona.

*Tackle the work just in front of you.
Strive in an honest way to do the best you
can, and if, having done your best, there
seems to appear the hand of some over-ruling
Power which hammers you, take it like a good
piece of steel and come right off the anvil with
a better temper and a keener edge.—C. W.
Post.*

NECESSITY FOR "SAFETY FIRST"

When the appalling number of industrial accidents is considered, the necessity for the Safety First movement is convincingly apparent. A multitude of strong men are each year being rendered useless to the community and non-supporting to themselves and families as a result of industrial accidents. The toll in death, in permanent disability and temporary loss of time, with suffering and want as the attendant on misfortune, is startlingly large. The few short months that the Board has been in close touch with the industries of the State, has revealed a remarkable desire on the part of the employers to co-operate in every way possible with the spirit of the law, relating to safety provisions. They realize that the necessity for the same is very pronounced. The propaganda of Safety First has been so widely diffused that people everywhere know what it means. The agencies teaching the principles of this life-saving creed are the insurance companies and the large individual employers of labor. It is gratifying to think of the work that is being accomplished along this line. The result is so apparent that every employer of any considerable number of men remarks on its wonderful results. Even in remote logging camps where accidents are only occasionally reported, and where doctors are not immediately available, in response to the question, "Was medical aid furnished by you?" the answer is written in "First Aid service at camp." Wherever "First Aid" is, "Safety First" has been there.

HOW TO AVOID THE SLING

*Watch your step;
Look before you reach;
Avoid dangerous piles;
Walk carefully on high places.*

IS THIS YOU?

There are still a lot of young fellows—and some old ones—in every business who do not exert themselves to the full extent of their ability for the reason that they are working for somebody else.

They have in mind that the someone else is getting the full benefit of their employment.

It is in a spirit of giving low service for low pay.

This is wrong, for as somebody said: "People who do not do any more than they are paid for, do not get paid for any more than they do."

Every man must first establish a reputation for ability and capacity with his own boss.

This reputation is soon extended to other bosses by various means, particularly through his fellow workers.

A man with ability and capacity at once establishes a competition for his services and by a natural law his price goes up.

For instance, take the superintendent of a big printing plant in one of these big cities. He knows the ability and capacity of practically every printer in town. He makes it his business to know.

The printing trade, like all other trades, is becoming divided up into specialties and whenever a particular man evidences skill and capacity the fact is known to rival employers and that man's market price goes above union scale.

In a certain printing plant in Cleveland there is this sign:

"We can not afford to turn out poor work at any price."

This is just as true of the individual workman as it is of an individual plant or corporation.

The reason this plant can not afford to turn out poor work is that it would injure its reputation for good work, and no individual workman can turn out poor work for exactly the same reason.

Every young man who begins work should take the same pride in any task set before him as he does in his personal appearance the first time he calls on a girl to whom he is attracted.

Take barbers in the downtown shops of a big city. Their compensation is based on percentage and the man who is in demand at the highest percentage is the one who is able to draw the largest personal following to the shop that employs him.

Naturally, the personal following is by reason of good workmanship.

The boss barber of every big shop makes it his business to know the reputation of every barber in every rival shop.

Or, take the sales people in the better grade stores of a city.

Each clerk is valued by his personal following and this he has worked up by ability and effort in salesmanship.

The personal following, the sales record of a salesman or a saleswoman becomes known to rival stores and the market price of the individual is entirely a matter of results in establishing that reputation.

Efficiency should be the religion of everyone, and it is simply doing well the task immediately before us.

The whole scheme of things both in nature and man creations is efficiency, and its reward is certain.

The other night a young actor was seated at a table in a restaurant after a performance. One of his friends said to him: "Why did you work so hard tonight? The audience was very small."

"Oh," replied the young actor, "Dave Belasco might have been in that small audience!"

Here is the spirit of the religion of efficiency—a young man who took no chance with indifference, but did his work just as if the eyes of the one whose approval he sought the most were upon him.

A RELIABLE MAN

"Let us have every mechanical device for safety that really promotes safety," the New York Sun remarks, adding: "Let us at the same time not lose sight of the greatest security of all—A RELIABLE MAN."

"WE HAVE DONE IT MANY TIMES THAT WAY"

How often after an accident we hear some one say, "Why we have done it many times that way." Yes, but it was the wrong way and the next time you try it, you get injured or killed. Because you do a careless or reckless thing several times and get away with it, that does not mean that you will always be so lucky.

There are many different ways of doing the same thing. There is the right way and the wrong way, the careless way and the careful way, the reckless way and the cautious way. The man who uses the right, careful, cautious way lives long and his family is happy. The man who uses the wrong, careless, reckless way is injured, crippled or killed and brings suffering and poverty to his family.—*Arizona Copper Company Bulletin.*

"SAFETY FIRST"

As we journey through life let us "live" by the way;
A saying of old that applies well today,
There is nothing so sweet as life after all,
So why take the chances that hasten "your call"?

You often save time by the "short cuts" you take
But whenever you do your life is at stake;
For the time you save would never repay
For the time you lose if you "slip" on the way.

Very often the safety of others depends
On the judgment you use, it may be a friend;
Or the loved ones at home, remember them too,
Their future depends on things that you do.

And this is a pretty good world after all;
There are times when our spirits may crumble and fall,
But there's never a time through the night or the day
When the chances we take are worth what we pay.

The "Safety First" way may seem longer and slow,
But it leads you past dangers you never may know,
So "now" is the time to look well ahead,
"Safety First" cannot help you after you're dead.

—C. J. Byrne.

The work of saving men from being injured or killed by accident offers a great common ground on which employer and employe can meet and co-operate. In this work there is no reason for distrust or partisanship but every reason why each should give his best because both gain in the transaction.

"SAFETY FIRST"

He—"I would give my life for you."
She—"Are you insured?"

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University of Arizona Bulletin

Celestite and Strontianite

BY
F. L. CULIN, JR.



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University of Arizona Bulletin

MINERAL TECHNOLOGY SERIES No. 13

OCTOBER 10, 1916

CELESTITE AND STRONTIANITE

Introduction:

The major part of the strontium salts used in the United States are imported, the production in this country being very small. In fact, no production has been reported since 1910. Deposits of strontium minerals are known to occur in Arizona, and it is thought that a description of strontium salts, the value and uses, may be of some value.

STRONTIUM MINERALS

There are two strontium minerals of commercial importance: celestite, strontium sulphate (SrSO_4) and strontianite, strontium carbonate (SrCO_3). Of these two, strontianite is the more valuable because it is more readily converted into salts desired for commercial purposes.

Strontium is a metal, but does not, to the writer's knowledge, occur as a metal in nature, nor is it commercially used in metallic form.

STRONTIANITE

Composition:—Strontium carbonate, SrCO_3 . Carbon dioxide (CO_2), 29.9%; strontia (SrO), 70.1%, equals 100%. A little calcium is sometimes present.

Form:—Crystalline. Crystals in the orthorhombic system. Crystals often acicular (needle-like) or spear shaped. Twins common. Also columnar, fibrous and granular.

Color:—Pale green, also white, gray, yellow and brown. Transparent to translucent.

Streak:—White. Lustre, vitreous (glassy) inclining to resinous.

Hardness:—Rather soft. (H. equals 3.5 to 4.) Brittle, breaks with an uneven fracture.

Weight:—Light. (Sp. Gr. 3.68 to 3.72.)

Occurrence:—Usually associated with gypsum and calcareous rocks, in beds. Also as geods in limestone and sandstone.

Blowpipe Tests:—Borax bead swells up, throws out minute sprouts, fuses only on thin edges, and colors flame strontia-red; assay reacts alkaline after ignition. Moistened with hydrochloric acid and heated by a flame imparts an intense red color to flame. Soluble in hydrochloric acid. Precipitated from this solution (dilute) by sulphuric acid, as white strontium sulphate. (SrSO_4).

CELESTITE

Composition:—Strontium sulphate, SrSO_4 . Sulphur trioxide (SO_3), 43.6%, strontia (SrO), 56.4%, equal 100%. Calcium and barium sometimes present.

Form:—Crystalline, orthorhombic system. Crystals commonly tabular or prismatic; also fibrous and radiated; sometimes globular; occasionally granular.

Color:—White, often faint bluish, sometimes reddish. Transparent to sub-translucent.

Streak:—White.

Lustre:—Vitreous (glassy) inclining to pearly.

Hardness:—Soft. (H. equals 3 to 3.5.)

Weight:—Light. (Sp. Gr. 3.95 to 3.97.) (High for such salts.)

Occurrence:—Usually in limestone or sandstone beds; occasionally with metalliferous ores; also in beds of gypsum and rock salt; also with sulphur in volcanic regions.

Blowpipe Tests:—Characterized by form, cleavage, high specific gravity, red coloration of the flame. Does not effervesce with acids. Specific gravity lower than barite.

USES OF STRONTIUM SALTS

The metal strontium is not used commercially, but its salts find various uses. The hydrate and the nitrate are the most important salts.

"Strontium hydrate is used principally in the recovery of sugar from beet molasses. The process is still employed in Germany and by the Raffinerie Parisienne, but the cost of hydrate is too great for its use to become general. Strontium sucrate (saccharate) is much more easily formed than calcium sucrate, and for this reason the celebrated German chemist, Carl Schiebler, of Berlin, has urged the use of strontium hydrate in sugar factories, especially as Germany has extensive deposits of strontium minerals from which it has been possible heretofore to obtain the hydrate cheaply. The beet molasses is mixed in suitable proportions with the hydrate, and the sucrate is formed. The mother liquors are separated by filter presses. The cakes of strontium sucrate are washed, then mixed with water, and carbonated. The strontium carbonate thus formed is burned to a caustic condition and used over again."

Strontium nitrate finds its chief use in pyrotechny, due to its property of imparting a red color to the flame.

Strontium in various forms, as the iodide, bromide, acetate, arsenate, phosphate, and other salts is used as medicine, and in the chemical laboratory.

According to the *Journal of the Society of Chemical Industry*, III, 1884, p. 33, "basic bricks are made from strontianite by mixing the raw or burnt strontianite with clay or argillaceous ironstone, in such proportions that the brick shall have about 10% silica, and then working it into a plastic mass with tar. After molding the bricks are dusted with fine clay or ironstone, dried and burned."

METHODS OF EXTRACTION AND PURIFICATION

Strontium is mined as the carbonate and sulphate, but, as stated before, is used as the hydrate and nitrate. Strontium hydrate is most simply made by calcination of the carbonate, strontianite. It is made from the sulphate by the reduction of the sulphate to the sulphide with charcoal or coal, the extraction of the sulphide with water and the subsequent precipitation of the hydrate by a metallic oxide or hydrate.

Strontium nitrate is made by dissolving the carbonate in nitric acid, if the native mineral can be procured sufficiently free from other bases that would consume the acid. The carbonate used is sometimes made from the sulphate by fusing with soda ash and leaching out the sodium sulphate formed.

THE STRONTIUM INDUSTRY

No figures are available showing any production of strontium salts in the United States for the past several years. The imports of strontium salts in 1915 were \$6,411, as compared with \$1,016 in 1914.

DEPOSITS OF STRONTIUM MINERALS

The metal strontium belongs to the same group as calcium and barium. It is found in small amounts in igneous rocks, in the form of the oxide (SrO); also in sea water and sea weeds, and in boiler scale.

Strontium and calcium are so closely related that their common association in rocks is to be expected. The natural sequence of chemically deposited sediments places strontium above a calcareous deposit and below gypsum.

Celestite is found associated with limestone or sandstone. It also occurs in beds of gypsum salt or clay. It is sometimes associated with metalliferous ores, as galena and sphalerite, and in volcanic regions with sulphur. In places it fills the cavities in fossils.

Strontianite occurs usually as granular masses and crystals, forming nests and geodes in limestone.

VALUE AND ECONOMIC CONSIDERATIONS

Strontium minerals as mined can hardly be given a value in the

United States, because the production has been so small. The price is very low, however, and probably would not exceed \$2.50 to \$4.00 a ton.

The demand for strontium minerals is rather small, and fluctuating. Therefore the material must be easily mined and readily accessible for shipment. It must also be very pure.

Strontium occurs in various states of the United States, as New York, Ohio, Texas, West Virginia, Michigan, Pennsylvania, Kansas, Colorado, Tennessee, California and Arizona. Celestite is by far the most common form in this country. In Arizona the strontium mineral is celestite. It occurs 15 miles south of Gila Bend, Maricopa County. Here the mineral occurs in sedimentary series associated with gypsum, sandstones, and conglomerates containing pebbles of coarse grained granite. The series is involved with igneous flows and intrusives.

The celestite occurs in beds overlain and underlain by sandstone beds and by igneous flows. The most promising beds here are 40 to 50 feet thick, and are most productive in the upper ten feet. The mineral is of a very good grade.

THE FUTURE OF THE INDUSTRY

Due to the scant demand and the inaccessibility of deposits, the strontium industry at present has only a potential value. When attention is drawn to important deposits, it is probable that a demand for the material will arise. The uses already discovered and the fact that most of the product used in the United States is imported, indicates that at some future time the more extensive deposits in this country may be worked. It is doubtful, however, if the industry will ever reach any great proportions.

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get
University of Arizona
Bulletin

The Selling of Copper

BY
H. J. STANDER



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METALLURGICAL SERIES No. 2

OCT. 17, 1916

THE SELLING OF COPPER

BY H. J. STANDER

When a metal takes such marvelous leaps in its price as copper has been doing during the last several months, it draws the attention of people who otherwise are not at all interested in the production, working and selling of that particular metal. Just at the present time all mining men, mining engineers and others are watching the price of copper with very great interest.

Before anything can be done with regard to the selling of an ore, it is necessary to know its composition as accurately as possible. In the case of a copper ore, one must know not only the percentage of copper or copper sulphide present, but also the percentages of all the other materials, because some substances in the ore may bring a bonus, whereas one is penalized for other substances should they happen to be present in the ore. The amount of both the bonus and the penalty will depend upon the percentages in which such substances appear. The basis on which the price of the ore is estimated is the price of the refined metal at the time the valuation is made, as quoted by some principal market center, such as New York.

It is very important to know the contents of an ore in gold, silver, copper, lead and zinc, if some or all of these metals be present. The ore is also quantitatively analyzed for the following: silica, sulphur, iron, alumina and lime, and sometimes also for antimony, arsenic, magnesia and barium. It is in lead and copper ores especially that one must know within narrow limits the amounts, in both the ores and the flux, of the silica, lime, magnesia, sulphur, iron and alumina, in order to control smelting operations.

After the percentages of all these substances have been determined, and the composition of the ore has been decided and agreed upon by the parties interested, it becomes possible for them to agree upon the valuation of the ore, and this valuation, as stated above, is also based upon the price of the refined metal, as quoted by the market at the time the valuation is made.

To obtain the gross value of the ore, one gets the sum of the products obtained by multiplying the metal contents, in pounds for the base metals and in troy ounces for the precious metals, per avoirdupois ton

by the prevailing price of the refined metals. To obtain the net value of the ore, the total cost of mining it, together with the charge for treatment is deducted from the gross value. The cost of treatment is determined by considering the freight charges to the treatment plant, the milling or smelting charges, compensation charges for loss of metal during the process of treatment, penalties on undesirable substances in the ore, freight charges to the refinery, charges for refining the metal, and charges for the selling of the refined metal. It thus becomes necessary for the buyer and purchaser, before they can agree upon the valuation of the ore, to consider some or all of these items.

Considering the cost of capital invested, labor, power, repairs, depreciations, etc., it is possible to ascertain a basic smelting charge per ton of ore, reckoning also a certain sum per ton for furnace charge. It is upon such a basic smelting charge that the smelting rates are based. Should an ore contain an excess of silica, a penalty is imposed based upon the amount of silica in excess of that which the furnace charge ought to contain, because, in order to take care of this excess amount of silica, the smelter has to provide an iron or lime flux. The amount of the penalty will then simply be the cost of this flux. Now very often the ore itself contains an excess of iron, and by an excess of iron is meant an amount of iron in the ore more than is required for the ideal furnace charge, and in such a case the excess quantity of iron may be sufficient to flux the excess amount of silica. In other words, the excess amounts of silica and iron just neutralize each other in the furnace charge, with the result that no penalty need be imposed. From this one will see that the mining of silicious and ferruginous ores need not necessarily be detrimental. This basis of determining smelter charges is known as the "neutral schedule."

It is easy to see that theoretically the smelter does not gain anything by using the "neutral schedule," in the determination of the smelting charges, yet it very often means some profit to them. It is assumed that in the ideal furnace charge one part of silica fluxes there is one part of iron or lime, and this is true in the case of copper smelting. But a bonus paid on a unit, or 1% per ton, of excess iron is about 5 to 10 cents, whereas the penalty on excess silica is about 10 to 15 cents. Thus the smelter can never lose when it uses the neutral schedule system, because if the excess is silica, it is multiplied by the penalty per unit, and this product is added to the smelting charges; whereas, should there be an excess of iron, it is multiplied by the bonus per unit and subtracted from the smelting charge. This is one way of determining the final smelting charge. Some smelters have quite a different system. After having obtained the amounts of excess silica and iron

respectively, they determine how much of either silica or iron there will be in excess, if every one part of the iron can be neutralized by one part of the excess silica present. Supposing that the excess amounts of silica and iron in the ore are in the ratio of 11 parts of silica to 10 parts of iron, the 10 parts of iron can be fluxed with 10 parts of silica, and the final excess of silica will then be 1 part. The seller is then penalized for this one part of excess of silica. Since the penalty on silica amounts to about 10 cents per unit, and the bonus on iron only to 5 cents, it is quite clear that such a method of calculating excess favors the silicious ore more than does the first system described above.

There are certain districts in which ferruginous ores are more common than siliceous ores, and in such cases the penalty may be placed on the iron, and the bonus given to the silica. Where silicious ores are in great demand, it is usually customary to base the smelting charge on the so-called "flat schedule." By a "flat schedule" is meant a fixed charge, paying no attention to the composition of the ore, as does the neutral schedule. The flat schedule is really based on an empirical value of the cost of smelting that particular ore, and since the percentage of the metal is never absolutely constant in an ore, the cost of smelting such an ore will vary with the amount of metal in it—in other words, the flat schedule is, in most cases, on a sliding scale. Thus, in the flat schedule the only thing considered is the percentage of metal in the ore, whereas the neutral schedule considers, besides this, the composition of the ore.

The smelting charges on high-grade ores are higher than those on the low-grade ores, when one considers the relative tonnage of each class. The smelting charges on low-grade ores are not much over the actual cost—in fact, in some cases, they are below actual cost. If, now, an average smelting rate had to be adopted, it would make it almost impossible to work very low-grade ores, and thus the sliding scale is the customary system used, because in such a case a low-grade ore can be worked much more profitably than when a melting charge, irrespective of the metal content, be imposed. One must, however, not forget that an increase in the metal content, means less gangue to be fluxed and the smelting operation then becomes cheaper. Thus, the smelter charges will decrease as the metal content increases, in the case of copper and lead ores, whereas this is not true to the same extent when the value of the ore is largely in gold.

In copper ores, the amount of copper present in the ore is usually determined by what is known as "wet analysis." Such a wet analysis can be carried out either electrolytically or volumetrically, and there are two volumetric methods, the iodide and the cyanide method. It is

also possible, however, to obtain the percentage of copper in an ore by a fire assay, but as the results are usually below the correct values, this method is not at all in general use. The smelter pays for the actual "yield" of copper in an ore, and this actual "yield" is usually the figure given by the wet analysis, less from 0.75 to 1.5%.

Thus, if an ore should contain copper less than, say 1%, the owner cannot expect the smelter to pay him for the copper in his ore. It is customary, then, to state in a contract on what basis the content of the metal shall be decided. Thus a contract may read that the percentage of copper in the ore shall be determined by the wet analysis less 1%. This would mean that if both parties agreed that the wet analysis on a given shipment of ore figured out to be 8.5% copper, the smelter will pay for only 7.5% copper in the ore, and 1% representing the loss in smelting as agreed upon in the contract.

The New York quotations on copper are always made on three types of copper. These types or bands are as follows:

- I. Electrolytic copper—ingots and wire bars.
- II. Electrolytic copper, not in the form of ingots or wire bars, but as cathods. This is simply the copper as deposited in its original form, without being melted afterwards.
- III. Casting copper, which is only reasonably pure.

Cathode copper is usually quoted at about 0.1 cent and casting copper at 0.2 cent less than wire bars. The smelter's deduction for copper from the New York quotations are as follows, in the case of lead ores containing copper:

From 1.5 to 5% copper—6 cents off casting copper quotation.

From 5 to 10% copper—5 cents off casting copper quotation.

More than 10% copper—4 cents off casting copper quotation.

Whereas the figures for the copper contained in copper ores are:

From 1.5 to 5% copper—5 cents off electrolytic copper ore.

From 5 to 10% copper—4½ cents off electrolytic copper ore.

From 10 to 20% copper—4 cents off electrolytic copper ore.

From 20 to 30% copper—3½ cents off electrolytic copper ore.

Over 30% copper—3 cents off electrolytic copper ore.

In order to recover the copper in a lead ore, it is necessary to treat the matte formed in the lead blast furnace, because as the lead ore is smelted the heavy metal, lead, collects at the bottom and carries with it the gold and silver and a little copper; while a matte is formed on top of this and contains chiefly iron sulphide, copper and perhaps a small amount of gold and silver. Then there is, of course, the slag on top of the matte; but the point is that this matte, formed in the smelting of a lead ore, is different from that produced in copper smelting,

in that it contains some lead. To treat the matte from a lead furnace to recover the copper is more expensive than the cost of recovering the copper in the matte from a copper smelter. It is for this reason that the figures given above, dealing with the smelter deductions from market prices for copper in the case of a lead ore containing copper are higher than those given for a copper ore.

PENALTIES

The penalties with regard to silica and iron in copper ore have already been mentioned, and the other materials in a copper ore on which a penalty is imposed are zinc, arsenic and antimony.

In the copper smelter one cannot recover the zinc, as it passes into the fume and fine dust, and into the slag. The slag can contain as much as 10% zinc without any considerable detriment, but when there is more than 10% zinc in a slag, it becomes viscid and causes trouble. Zinc is also detrimental to the furnace itself, in that it forms incrustations in the furnace; and a further trouble brought about by the presence of zinc in a copper ore is that the zinc in volatilizing will carry some of the metal with it, as it causes volatilization of the copper also. The penalty on zinc is about 30 to 50 cents per unit above 10% zinc present. This means about 30 to 50 cents for every 20 pounds of zinc, about 200 pounds in a ton of ore. This is a very heavy penalty and encourages the separating out of the zinc in the mill, because it then becomes possible not only to escape paying the zinc penalty to the smelter, but very often to make a zinc product which can be sent to a zinc smelter.

Arsenic is occasionally penalized in copper smelting, and this also applies to antimony. Both arsenic and antimony will form, together with the copper and iron, a so-called "speiss." This speiss is a very undesirable by-product in that it is very costly to treat for the recovery of the metals contained in it. A penalty is thus usually imposed on an arsenic and antimony content greater than 1%.

The main markets for copper are New York, London and Hamburg. All the big nations, with the exception of Russia, have agreed that no duty shall be imposed on either the importation or the exportation of copper, so that the copper market is the same throughout the world. The few selling agencies in New York handle almost all the copper produced, while there are only a few of the producers that sell their copper direct.

There are four kinds of copper sold; they are:

- I. Lake copper, i. e., that coming from the Lake Superior district.
- II Electrolytic copper. This is the refined copper, and these

copper refineries usually refine the copper coming from the west.

III. Pig copper.

IV. Casting copper.

These last two kinds of copper are somewhat impure, as the pig copper does not contain enough silver to pay for its refining and the casting copper is made from old scrap copper. As has been mentioned before, there are two kinds of electrolytic copper, the bars and the cathode, but the cathode copper is somewhat uncommon at the present time. Lake copper still has a premium of about $\frac{1}{4}$ cent over electrolytic copper, although the electrolytic copper is very often better in its electrical conductivity than the Lake copper, but this premium is perhaps only a result of the reputation the Lake copper has had in the past.

THE FORMS IN WHICH COPPER IS MARKETING

- I. Pigs, similar to the pigs of cast iron, weighing 100 pounds each.
- II. Rectangular cakes of different sizes.
- III. Ingots, like the pigs, but partly divided into two or three sections, so as to make it easy to break it for introduction into crucibles used for melting.
- IV. Ingot bars, partly divided into 3 to 5 parts. These bars weigh from 60 to 90 pounds.
- V. Wire bars, tapering towards one end.

"OPEN SCHEDULES" FOR COPPER-LEAD-GOLD-SILVER ORES

The schedules given below are in force in the western sections of the United States.

1. Lead-copper ores, containing gold and silver. *Neutral schedule.*
 Gold, \$19.50 per ounce of 0.05 ounce or over per ton.
 Silver, 95% of contents, date of assay.
 Lead (dry)—Prices are based on \$4 quotation.
 Copper—For dry copper, which is 1.5% off wet, 6 cents off per pound on Western Union quotation for casting copper.
 Zinc—10% allowed, and 50 cents penalty per unit, in excess of this.
 Silica—Penalty, 10 cents per unit; iron bonus, 10 cents per unit.
11. Copper ores containing gold and silver. *Neutral schedule.*
 Gold—\$19 per ounce if product contains 0.03 ounce or over per ton.
 Silver—95% of contents at New York quotation, date of assay.
 Copper—As per wet assay, less 1% of unit, at the price for

Cathode copper quoted in the Engineering & Mining Journal, issue of week previous to date of receipt, less 2½ cents per pound. (This price changes according to supply and demand conditions.)

Iron—Paid for at 10 cents per unit.

CHARGES

Insoluble—10 cents penalty per unit.

Zinc—10 per cent allowed free; excess at 25 cents per unit.

Speiss—10 per cent allowed free; excess at 25 cents per unit.

Treatment charge—\$3 per ton.

The above prices are an average but vary considerably under local conditions. For instance, many localities may have an excess of silicious ores which will cause an increased bonus to be paid for iron ores, and vice versa, districts supplying large quantities of ores heavy in iron may have a larger percentage of silica without penalty.

The ascertaining of a correct smelter charge takes so many factors into consideration that it is generally misunderstood by the seller of ore; he ordinarily believes that he should merely be paid for the copper, gold and silver and whatever other metals it contains, not realizing that in smelting operation it is impossible to obtain all of the copper; that in selling the metallic copper the full quoted market price is not obtained; that the copper produced at the smelter is not purified copper ready for the market; that there are many things in the ore which cause additional flux, which contain no value to be purchased and handled.

In order to successfully operate a smelter, the mixtures going to the furnaces cannot be varied from hour to hour or even from day to day; hence to get the proper mixture of ores, the smelters desire large and regular shipments. A small shipment is as much work for the assaying and general charges as a large shipment; hence it is not unreasonable to expect that the costs of smelting will be greater for small shipments. Small shipments influence the mixtures and often upset considerable routine operation. In the case of the excessive supply, and the working of the smelters to their fullest capacity, it is often true that smelters will refuse to accept small, irregular shipments.

Another point generally misunderstood is the fact that while the smelter is paying for ores received, based on prices upon the day or week of the purchase, they do not receive the payment for the metal produced for some 90 or 100 days—hence fluctuations on the market must play a very considerable part in the fixing of smelter prices.

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BY

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COPPER

By P. E. JOSEPH

Introduction:—The copper industry in the United States has enjoyed a year of unparalleled prosperity during 1915. It is needless to explain the conditions which have so greatly affected our copper market, as they are really self-evident, but I shall endeavor here to outline the possible conditions of the future copper market, which would be created by the termination of the European war.

The opinions regarding this question are many and greatly diversified, and many hold the belief that the termination of the war will result in a decline of the copper prices to a very low level. However, the consideration of the following facts will be of help in the formation of a more or less definite conception as to what the effect of the cessation of war might be upon the copper market.

1. War results in the destruction of wealth, which has to be replenished. History shows that all previous wars have been followed by long periods of great industrial activity.

2. The warring nations have practically exhausted their supply of copper, and are now using copper available in any form for the manufacture of ammunition, which copper is destroyed by the war and lost to the world.

3. Factories and railroads are now overtaxed with operations to such an extent that the amount of copper needed to rebuild their equipment may be larger than that used in the manufacture of war munitions.

4. The present rate of consumption is considerably in excess of the producing capacity of this country, and at the close of the war not only Europe will be bare of copper, but this country as well.

5. European manufacturers of copper and brass products will attempt to regain the foreign trade of which the war is depriving them, as well as to supply their own countries with all the copper and brass goods they use, and in order to do this, they will have to buy heavily of the American copper.

6. In all the buying countries of the world, with the exception of those at war, such financial conditions have been created by the war as to restrict their purchases of manufactured goods. The termination of the war will eliminate these abnormal conditions and thus create

greater market for the copper and brass products of European manufacturers.

Of course, a sudden cessation of war would cause the cancellation of war orders, and considerable copper which has been purchased for future delivery would be released; but the owners of this are American copper and brass manufacturers, who would be obliged to retain it to keep their own operations going.

From the above considerations, we may safely conclude that after the war there will be a stronger demand for copper than existed before, and probably than existed during the war.

ORES OF COPPER

Copper is a very common and widespread metal in nature, and it constitutes from about 0.01 to 0.005 per cent of the earth's crust. It is a common constituent of sea water, and the green color of the sea has been attributed to its presence. It has also been obtained in the ashes of sea weeds and found in certain varieties of corals. Copper is easily oxidized and easily reduced as well, and it therefore is found both as native and in its many different compounds.

In addition to the minerals described below, copper is very frequently found in the iron sulphides from which it is extracted after burning for sulphuric acid.

COPPER—NATIVE COPPER

Composition:—Cu, often containing gold, silver, and sometimes mercury or bismuth.

General Description:—A soft, red, malleable metal. Usually in sheets or disseminated masses, varying from small grains to several hundred tons in weight. Sometimes in threads and wire and in distorted crystals and twisted groups.

Physical Characteristics:

Hardness (2.5 to 3), easily scratched by knife; Sp. Gr. very heavy (8.18 to 8.9).

Lustre, Metallic.

Opaque.

Streak, copper red.

Tenacity, brittle.

Color, copper red, tarnishing nearly black.

Qualitative Tests—Fuses easily to a malleable globule, often coated with a black oxide. In beads of borax or salt of phosphorous, it becomes green when hot, blue when cold in oxidizing flame; in reducing flame it becomes opaque red. In nitric acid it dissolves readily, with the evolution of a brown gas, yielding a green solution. If iron, steel, zinc or aluminum is immersed into this solu-

tion and the solution is allowed to stand, they will be coated with a layer of copper. On adding ammonia the solution becomes deep azure blue.

Native copper resembles nicolite and tarnished silver, from which it differs in its copper red streak.

CHALCOCITE—COPPER GLANCE

Composition:—Cuprous sulphide (Cu_2S) containing 79.8% copper and 20.2% sulphur.

General Description:—A black, heavy, metallic mineral, often coated with the green carbonate, malachite. Occurs in small tabular crystals of hexagonal outline; in granular or compact masses; or in nodules and pseudomorphs after wood.

Physical Characteristics:—

Hardness (2.5 to 3), easily scratched by knife. Sp. Gr. heavy (5.5 to 5.8).

Lustre, metallic.

Opaque.

Streak, grayish-black.

Tenacity, brittle.

Color, shining lead-gray, tarnishing fracture, conchoidal on exposure to dull black.

Qualitative Tests:—Bead reactions are same as described under native copper. On charcoal with soda it fuses to a malleable copper button if heated in the reducing flame, and also gives a very strong sulphur reaction. It is soluble in nitric acid, leaving a residue of sulphur. If moistened with hydrochloric acid, it colors the flame azure blue.

Occurrence:—Chalcocite is a secondary mineral produced by secondary (downward) sulphide enrichment. It is found in the enriched zone of copper veins, associated with bornite, chalcopyrite, enargite, malachite, pyrite, etc. In the ores of Virgilina district, Va., it is found to be of primary origin, or deposited from ascending solutions.

BORNITE—PURPLE COPPER ORE—(HORSE FLESH ORE)

Composition:—(Cu_5FeS_4). A copper-iron sulphide, containing 63.3% copper, 11.2% iron and 25.5% sulphur.

General Description:—On fresh fracture bornite is of a peculiar red-brown color and metallic lustre. It tarnished to deep blue and purple tints, often variegated. It is massive in texture, though cubes and other isometric crystals are found.

Physical Characteristics:

Hardness (3), easily scratched by knife. Sp. Gr. (4.9 to 5.4), heavy.

Lustre, metallic.

Opaque.

Streak, grayish black.

Tenacity, brittle.

Qualitative Tests:—When heated on charcoal it blackens, becomes red on cooling and finally fuses to a brittle, magnetic globule and evolves sulphur dioxide fumes. In oxidizing flame with borax or salt of phosphorous, gives green bead when hot, greenish blue when cold, and in reducing flame the bead is opaque red. Is soluble in nitric acid with separation of sulphur.

Occurrence:—Bornite is an important and widely occurring ore of copper, usually associated with other copper minerals and in subordinate amounts. It is mostly of primary origin (derived from ascending, hot, alkaline solutions) and is found in the enrichment zone as residual masses undergoing alteration. It is frequently associated with primary chalcopyrite and chalcocite. The other minerals with which it is associated are enargite, malachite, azurite, pyrite, etc.

CHALCOPYRITE—(COPPER PYRITES—YELLOW COPPER ORE)

Composition:—(CuFeS_2) a sulphide of copper and iron containing 34.5% copper, 30.5% iron, and 35.0% sulphur, with mechanically intermixed pyrite sometimes.

General Description:—A bright, brassy yellow mineral of metallic lustre, often with iridescent tarnish, resembling that of bornite. Usually massive, sometimes in crystals.

Physical Characteristics:

Hardness (3.5-4), scratched by knife. Sp. Gr. (4.1-4.3), heavy.

Lustre, metallic.

Opaque.

Streak, greenish black.

Tenacity, brittle.

Color, bright brass yellow, often tarnished blue, purple and black.

Qualitative Tests:—On charcoal fuses to a brittle magnetic globule. With soda yields metallic malleable red button and sulphur reaction as under chalcocite. In closed tube decrepitates, becomes dark and iridescent and may give deposit of sulphur. Bead and acid tests same as under bornite.

Occurrence:—The most common ore of copper and is found in association with the metallic sulphides and other copper ores, many of which have been formed by its alteration. Frequently carries gold

and silver. Often in subordinate amounts with large bodies of pyrite, constituting low-grade copper ores.

ENARGITE

Composition:—(Cu_3AsS_4), a sulph-arsenide of copper, containing 48.3% copper, 19.1% arsenic and 32.6% sulphur; sometimes the copper is replaced by zinc and iron, and the arsenic by antimony.

General Description:—A black, brittle mineral of metallic lustre, occurring usually columnar or granular, but sometimes in crystals.

Physical Characteristics:

Hardness (3), easily scratched by knife. Sp. Gr. (4.43 to 4.45), moderately heavy.

Lustre, metallic.

Opaque.

Streak, blackish-gray.

Tenacity, brittle.

Color, black or blackish-gray.

Qualitative Tests:—On charcoal fuses, yields white fumes with garlic odor (arsenic test). With soda yields malleable copper button and reaction for sulphur. In closed tube decrepitates, yields sulphur sublimate, then fuses and gives red sublimate of arsenic sulphide. Soluble in nitric acid.

Occurrence:—Enargite is a comparatively rare mineral found in association with other copper minerals, especially the arsenates derived from it.

TETRAHEDRITE—GRAY COPPER ORE

Composition:—($\text{Cu}_8\text{Sb}_2\text{S}_7$), a sulph-antimonide of copper, containing 52.1% copper, 24.8% antimony and 23.1% sulphur. The copper is often replaced in varying amounts by iron, zinc, silver, mercury, lead, etc., and the antimony by arsenic.

General Description:—A heavy, dark lead gray mineral, occurring in crystals; also massive and coarse to fine granular. Sometimes coated with yellow chalcopyrite.

Physical Characteristics:

Hardness (3 to 4.5), scratched by knife. Sp. Gr. (4.5 to 5.1), heavy.

Lustre, metallic.

Opaque.

Streak, black or reddish brown.

Tenacity, brittle.

Color, light steel to dark lead gray or iron black.

Qualitative Tests:—On charcoal fuses to a globule which may be slightly magnetic. Evolves heavy white fumes (antimony test) with sometimes a garlic odor, due to arsenic. The roasted residue gives bead and flame reactions for copper. Soluble in nitric acid to a green solution with white residue.

Remarks:—Resembles arsenopyrite and metallic cobalt ores from which it differs in softness and in that it does not yield a strongly magnetic residue on heating.

Occurrence:—Usually in metallic veins in association with the sulphides of lead, silver, copper, etc. May carry silver in sufficient amounts to become an ore of that metal.

CUPRITE—RED OXIDE—RUBY COPPER ORE

Composition:—(CuO), an oxide of copper containing 88.8% copper and 11.2% oxygen; sometimes intermixed with limonite.

General Description:—A heavy reddish mineral, occurring in fine-grained masses or in transparent crystals.

Physical Characteristics:

Hardness (3.5 to 4), scratched by knife. Sp. Gr. (5.85 to 6.15), heavy.

Lustre, adamantine to dull.

Transparent to opaque.

Streak, brownish red.

Tenacity, brittle.

Color, crimson, scarlet, vermillion.

Qualitative Tests:—On charcoal blackens and fuses easily to a malleable red button. Copper flame and bead tests. Soluble in nitric acid to a green solution. Soluble in strong hydrochloric acid to a brown solution, which, on dilution with water, gives a white precipitate.

Occurrence:—Cuprite is an important ore of copper of secondary origin, occurring in the oxidized portions of copper veins in association with other secondary minerals of copper, such as native copper, carbonates and silicates.

MALACHITE—GREEN CARBONATE OF COPPER

Composition:— $\text{Cu}_2(\text{OH})_2\text{CO}_3$, a hydrated carbonate.

General Description:—A bright green massive mineral, often in crusts with a delicate, silky, fibrous structure or banded in lighter and darker shades of green. Frequently pseudomorphous after, and coating other copper minerals.

Physical Characteristics:

Hardness (3.5 to 4), scratched by knife. Sp. Gr. (3.9 to 4.03), moderately heavy.

Lustre, silky, adamantine or dull translucent to opaque.

Streak, pale green.

Tenacity, brittle.

Color, bright emerald to grass green and nearly black.

Qualitative Tests:—On charcoal decrepitates, blackens, fuses, and colors the flame green, leaving a globule of metallic copper. Heated in closed tubes, blackens, yields water and carbon dioxide. Soluble in acids with effervescence.

Occurrence:—A secondary mineral found in the copper oxidized zones and derived from other copper minerals by the action of carbonated waters.

AZURITE—BLUE CARBONATE OF COPPER

Composition:— $\text{Cu}_3(\text{OH})_2(\text{CO}_3)_2$, a hydrated carbonate of copper.

General Description:—Dark blue, glassy crystals. Also massive, in which it may be glassy, velvety or dull and earthy. Also forming crusts on other copper minerals or filling cracks within them.

Physical Characteristics:

Hardness (3.5 to 4), scratched by knife. Sp. Gr. (3.77 to 3.83), moderately heavy.

Lustre, vitreous.

Translucent to opaque.

Streak, blue.

Tenacity, brittle.

Color, dark blue to azure.

Qualitative Tests:—Same as for malachite.

Occurrence:—As malachite.

CHRYSOCOLLA

Composition:— $(\text{CuSiO}_3 + \text{H}_2\text{O})$, a hydrated silica; often very impure.

General Description:—A green to blue mineral, forming crust or seams, which resemble opal in texture. Also brown, like limonite, and in dull green earthy masses.

Physical Characteristics:

Hardness (2 to 4), easily scratched by knife. Sp. Gr. (2 to 2.3), light.

Lustre, glassy to dull.

Translucent to opaque.

Streak, white to pale blue.

Tenacity, brittle.

Color, green to light blue, brown when ferriferous.

Qualitative Tests:—Infusible but turns black, then brown and colors flame emerald green. In closed tube yields water. Decomposed

by hydrochloric acid, leaving a white residue of silica. Gives test for copper.

Occurrence:—A comparatively rare mineral, found in the oxidized zones of copper veins and is probably derived by the action of hot alkaline silicate solutions on other copper ores.

Other minerals of copper are:—

Tenorite—the black oxide of copper.

Stalamite—green hydrated oxychloride.

Chalcantite—blue vitreol or sulphur.

Brochantite—green sulphate.

Liebethenite—olive green phosphate.

Olivenite—olive green arsenate.

Dioptase—emerald green ortho-silicate.

ORIGIN OF COPPER ORES

According to their origin, the ores of copper may be divided into five groups:

1. Deposits formed by differentiation of the magma. These are irregular in shape, but are usually marginal with respect to the solidified magma from which they were derived. In the United States no workable deposits of this origin are known.

2. Deposits formed by ascending alkaline hot solutions depositing ores in fissures, pores, shear zone and brecciated zones, and by replacement of rocks.

3. Lens-shaped deposits in crystalline schists formed by concentration of the valuable material from a disseminated condition in the surrounding rock. These are usually of low grade.

4. Contact Deposits—These deposits are formed by contact metamorphism, or the reaction which takes place between an intrusive igneous rock and the country rock forming the wall rock of the intrusive. Both the country rock and, to a less degree, the intrusive are metamorphosed on the contact, the effects of metamorphism, being strongest on the contact and growing weaker away from the contact. Among the intrusives that are most commonly associated with contact deposits, and are thus considered to be most favorable for the formation of contact deposits, are the acid intrusive rocks high in silica, such as granites, syenites, diorites, and the intermediate types, monzonites, and granodiorites, are known to produce the largest zone. The wall rocks most susceptible to contact metamorphism and the formation of contact deposits are slate, shales and limestones, the limestones being most favorable.

The ore minerals are usually chalcopyrite and bornite associated with pyrite.

5. Disseminated Deposits.—These deposits usually occurring in igneous rocks or schists, are formed by the impregnation of the more or less fractured country rock with copper-bearing magmatic waters from which copper sulphides are precipitated.

The last two types constitute by far the most important deposits, especially in the Southwest. In each case the deposits usually suffer some change by oxidation and secondary enrichment. The ores within the zone of weathering partly undergo a chemical change, such as oxidation, carbonation, hydration, and partly are leached by the circulating surface acid waters and carried to lower levels to be there precipitated—giving rise to secondary enrichment.

PRODUCTION OF COPPER IN THE UNITED STATES

Table Showing Production of Copper in the United States, 1910-1915, by States in Pounds.

State—	1910	1911	1912	1913	1914
Alaska	4,311,026	22,314,889	31,926,209	27,324,070	24,985,897
Arizona	297,250,538	302,202,532	359,322,096	404,278,809	382,449,922
California	45,760,200	35,535,651	31,516,471	32,492,265	29,784,173
Colorado	9,307,497	9,791,861	7,963,520	9,052,104	7,316,066
Idaho	6,877,515	4,514,116	7,182,185	8,711,490	5,875,205
Michigan	221,462,984	218,185,236	231,112,258	155,715,286	158,009,748
Montana	283,078,473	271,814,491	308,770,826	285,719,918	236,805,845
New Mexico..	3,784,609	2,860,400	29,170,400	50,196,881	64,204,703
Nevada	64,494,640	65,561,015	83,413,900	85,209,536	60,122,904
Oregon	22,022	125,943	311,860	77,812	5,599
So. Dakota....	43	1,607	23,657	4,549	.....
Utah	125,185,455	142,340,215	132,150,520	148,057,450	160,589,660
Washington ..	65,021	195,503	1,069,938	732,742	683,602
Wyoming	217,127	130,499	25,080	362,235	17,082
Eastern States and Unappor- tioned	18,342,359	20,538,791	19,310,298	20,449,951	19,286,836
Total.....	1,080,159,509	1,097,232,749	1,243,268,720	1,224,484,098	1,364,618,500

COPPER INDUSTRY IN ARIZONA

The United States is the leading copper producing country of the world. About 75% of the total production is furnished by the states of Arizona, Michigan and Montana, with Arizona yielding about one-third of the total production in 1914 and 1915. In fact, if the present high prices will continue, in the course of a very short time, a sufficient number of copper properties might be developed in Arizona to easily double its already enormous production.

The steady output of copper from Arizona began in 1875 with the earliest record of production being for 1862. Since 1880 the growth of the industry has been steady and very rapid, and at the close of 1914 Arizona had produced 4,649,437 pounds of copper, or 23.24% of the total output of the country.

DESCRIPTION OF THE COPPER DISTRICTS OF ARIZONA

In describing the districts only such features are noted which may be helpful in learning the geological occurrence of copper deposits in Arizona, the knowledge of which is of unquestionable importance to the prospector.

THE BISBEE DISTRICT

According to Ransome, the oldest formation in the Bisbee district is the Pinal schist, which has been intruded by granite, probably of pre-Cambrian age. These form the complex basement upon which the Paleozoic sediments, chiefly limestones with quartzite at base, have been deposited. In the Mesozoic time, these sediments have been intruded by stocks, sills and dikes of granite porphyry. Then followed a period of erosion, after which the Cretaceous sediments were deposited, which have since been removed from the producing area.

The primary ores, which are chiefly pyrite and chalcopyrite, were deposited during and after the intrusion of the Mesozoic granite porphyry, and their association with contact metamorphism minerals, such as garnet, diopside, tremolite, etc., has led to the belief that the ores are contact deposits.

The primary ores, however, have been oxidized and enriched by surface solutions, and a large part of the ore extracted was in the form of secondary sulphides, oxides, and carbonates. Most of the ore bodies are irregular in shape, and have no definite arrangement, making the cost of prospecting rather high.

This district, which is situated in southern Cochise county, is one of the oldest and biggest producers, ranking third among the copper districts of the country in total and present output.

MORENCI-METCALF DISTRICT

The deposits of this district are at Morenci and Metcalf, in Greenlee county. The district lies in a basin six to ten miles across, surrounded by hills of Paleozoic, probably carboniferous limestone, resting on sandstones underlain by granites. The basin consists of a mass of porphyry with frequent limestone inclusions. Felsite and porphyry dikes are also present in the surrounding sedimentary or granite rocks. Several miles to the east there is an outflow of trachyte and evidence of recent volcanic action. The ores may be classified as follows:

1. Contact deposits. These ores occur in the limestone along the intrusive porphyries, and in a zone of highly kaolinized porphyry, along the contact with the limestone.

Some deposits have been formed in outlying bodies of limestone which have been mineralized by ore channels from the contact. The

ores, originally pyrite and chalcopyrite, have later been oxidized and secondarily enriched, giving rise to malachite, azurite, cuprite, some metallic copper, and melaconite. The ores are associated with limonite, some wad, and clay of a residual character.

2. Disseminated deposits. These deposits form sheets and pockets in the highly altered porphyry near the fissure veins and impregnate the solid rock itself. The ores have been largely leached on the surface and deposited as chalcocite on the pyrite lower down. The gangue material is a kaolinized porphyry.

3. Vein deposits of the Coronado type. These are true fissure veins, cutting across a quartz porphyry dike. On the surface the ore is chalcocite which has resulted from enrichment of the chalcopyrite below. These deposits have been found to extend in depth below the general level of the ore zone. The average content of the ores is about 1.95% copper, and small amounts of gold and silver, but in as much as the copper is not refined electrolytically, the precious metals are not recovered.

The district is one of the oldest copper producers in the state. Its total production has yielded about 6% of the output of the country since 1845 and about 25% of the copper output of the state.

GLOBE DISTRICT

The geology of this district may be summarized as follows:

Paleozoic sediments, consisting of conglomerates, quartzites, shales, and schists, have been laid down unconformably on pre-Cambrian schist (Pinal schist) and intruded granites. Later these sediments were intruded by diabasic and still later by granitic rocks. After a period of erosion, the area was buried beneath Tertiary volcanic and sedimentary rocks, which have since been partly eroded.

In the Miami end of the district, the ore bodies occur chiefly in small veins of quartz and sulphide in the shear zone near the granite and schist contact. The ores near the surface have been leached and redeposited as chalcocite on the sulphides below. The commercial ore consists of grains of pyrite and chalcopyrite, partly or wholly replaced by chalcocite disseminated through the schist and granite along the contact.

In the Globe end of the district the deposits form lenticular replacements, in the limestone and fissure zones of quartz and sulphides in the diabase. Most of the commercial ores have been oxidized and enriched, though some primary ores of commercial grade have been developed.

The content of the ores varies from 1.26% to 7.18% copper, with an average yield of about 2.4% copper and some gold and silver.

Production of copper began here in 1881, though before this it was known as a silver producer. For several years subsequent to 1881 the production was intermittent. But since 1889, when a railroad reached the camp, it has become an important producer of copper, having yielded 2.92% of the output of the country since 1845 and 12.5% of the output of the state.

In Miami important production began in 1911, and this end of the district will continue to grow in importance.

THE JEROME OR VERDE DISTRICT

Here the deposits occur in pre-Cambrian schistose rocks which have resulted from metamorphism of dioritic, rhyolitic and possibly sedimentary rocks.

The ores, consisting chiefly of chalcopyrite, with varying amounts of pyrite and sphalerite, occur partly in small irregular fractures, and along planes of schistosity, but to a large extent as metasomatic replacements of the schist, particularly the fine grained sericitic variety. The sulphides are primary and were all deposited in the pre-Cambrian era.

The most important producer in this district is the United Verde Copper Company. This district ranks sixth among the copper districts of the country and third in Arizona.

MINERAL CREEK OR RAY DISTRICT

In geology this district is very similar to the Globe district described above. The ore deposits are of two types, namely those formed in the sedimentary rocks near the faults and fissures, and the disseminated deposits in the schist and granite. The ores of both types are believed to have been introduced at the time of and closely following the granitic intrusion.

TURQUOISE DISTRICT

The rocks in this district, which is situated in Cochise county, consist of Paleozoic sediments, chiefly limestone, extensively faulted and intruded by monzonitic porphyries. The ore bodies here occur as replacements and veins in the intrusive monzonites.

SILVER BELL DISTRICT, PIMA COUNTY

Here the rocks consist of Paleozoic sediments cut by granite porphyry. The district has yielded about 40,800,000 pounds of copper.

AJO DISTRICT, PIMA COUNTY

The rocks of this district consist of a series of lavas, breccias, and tuff, which have been cut by stocks of quartz monzonite porphyries

and similar rocks. The original copper deposits consist of small veins, containing chalcopyrite and bornite mostly, in the intrusive rocks, but also in the extrusives.

Other districts of the state making important production are the Big Bug, Yavapai county; Cochise, Cochise county; Palmetto and Patagonia, Santa Cruz county; Pioneer and Bunker Hill, Pinal county; Pima, Pima county; Bentley, Mohave county; and the Borner, Gila county. There are at least 140 mining districts in Arizona with copper in almost all of them, but for the most these lack sufficient development and could not be considered as producers.

GRADES OF AMERICAN COPPER

There are four grades of copper on the American market:

1. Lake copper: Tough and ductile copper, obtained from the Lake Superior mines. It contains 99.8% copper, small amounts of arsenic and silver, and is sold in form of ingots, slabs and cakes.
2. Electrolytic copper: Electrolytically refined copper of highest purity and conductivity. Contains 99.9% copper and is sold in form of ingots, slabs, cakes and wire bars.
3. Standard or Pig copper: This is a medium grade copper suitable for brass and bronze alloys and is sold in form of ingots.
4. Casting copper: A low grade copper suitable for casting only. It is made by melting and casting scrap copper, has a low conductivity and is sold in form of ingots.

METALLURGY OF COPPER

Copper may be extracted from its ores in three different ways:

1. Smelting.
2. Leaching.
3. Electrically.

For further information regarding this subject, see Bulletin No. 36, Arizona State Bureau of Mines, which may be obtained by writing Charles F. Willis, Director, Tucson.

USES

The properties of copper, such as its conductivity, malleability, etc., make it one of the most useful metals known. In fact, the uses are so numerous and for the most part well known to all, that the writer does not think it necessary to describe them on these pages.

PRICES

The following table shows the average monthly prices at New York per pound of electrolytic copper in cents.

Price of Electrolytic Copper in Cents

Months—	1912	1913	1914	1915	1916
January	14.27	16.755	14.45	13.60	24.30
February	14.26	15.27	14.67	14.38	26.62
March	14.78	14.925	14.335	14.80	26.65
April	15.85	15.48	14.34	16.64	.....
May	16.16	15.63	14.13	18.71	.....
June	17.29	14.85	13.81	19.75	.....
July	17.35	14.57	13.49	19.09	.....
August	17.60	15.68	12.415	17.27	.....
September	17.67	16.55	12.085	17.69	.....
October	17.60	16.54	11.40	17.90	
November	17.49	15.47	11.74	18.88	
December	17.505	14.47	12.93	20.67	



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Safety Series No. 12

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TUCSON, ARIZONA

1916-17

.....1916

J. T. MORE, Secretary,
SOUTHWESTERN MINE SAFETY ASSOCIATION,
Ray, Arizona.

Enclosed please find ^{money} order for Three Dollars (\$3.00)
_{check}
for membership in the Southwestern Mine Safety Association for
the year 1916.

Address.....

.....

State Safety News

Safety ***Efficiency***

SAFETY SERIES No. 12

OCTOBER 31, 1916

What Is the Most Important Event in November?

THE
THIRD ANNUAL

Mine Rescue and First Aid Contest

Where Is It to Be Held?

PHOENIX, ARIZONA.
TUESDAY, NOVEMBER 14, 1916.

Who Is Going to Enter?

Old Dominion Copper Mining and Smelting Company
The Detroit Copper Mining Company
Copper Queen Consolidated Mining Company
Calumet and Arizona Mining Company
Ray Consolidated Copper Company

What Are the Prizes?

Mine Rescue Contest:

First Prize: \$100.00 in cash and State Fair Association Trophy.

Second Prize: \$75.00 in cash.

Third Prize: \$25.00 in cash.

First Aid Contest:

First Prize: \$100.00 in cash and State Fair Association Trophy.

Second Prize: \$75.00 in cash.

Third Prize: \$25.00 in cash.

Who Is Responsible?

SOUTHWESTERN MINE SAFETY ASSOCIATION

Who Are Its Officers?

President:

LOUIS S. CATES, Ray Con. Copper Co., Ray, Arizona.

Secretary-Treasurer:

J. T. MORE, Ray Con. Copper Co., Ray, Arizona.

Executive Committee:

LOUIS S. CATES, Ray Con. Copper Co.

NORMAN CARMICHAEL, Arizona Copper Co.

EDGAR A. COLLINS, Commonwealth M. and M. Co.

WILL L. CLARK, United Verde Copper Co.

F. W. MAGLENNAN, Miami Copper Co.

J. T. MORE, Ray Con. Copper Co.

Chairmen of Standing Committees:

*Safety Methods and Accident Prevention: I. H. BARKDOLL,
Old Dominion Copper M. & S. Co., Globe, Arizona.*

*First Aid Training and Contests: GEO. W. SALISBURY,
Jerome Victor Extension Copper Co., Jerome, Arizona.*

*Rescue Apparatus Training and Contests: CHAS. A. MITKE,
Copper Queen Con. Mining Co., Bisbee, Arizona.*

*Membership and Finance: L. M. BANKS, Arizona Copper
Co., Morenci, Arizona.*

Who Are Its Members?

Everyone interested in safety work.

If you are not, see blank on back of cover.

Who Will Win the Contest?

?

Will tell you that next month.

Hello, Bill! See you at the State Fair.

Everyone interested in safety work, and that means every one interested in mining, should see the First Aid and Mine Rescue Contest to be held during the State Fair at Phoenix, November 14th. They should see it for the promotion of interest in safety work, they should see it to cheer their teams on to victory. It will be noted from the list of entries that several of the larger companies of the state are not sending teams this year. While this oversight and neglect cannot be corrected for this year's contest, start right now and see that it does not happen again.

SAFETY AT INSPIRATION. THEIR MAN HOIST.

BY W. G. WEBER, SAFETY ENGINEER.

The Inspiration Copper Company is ever awake to safety devices and in the new machinery installed everything that tends towards increased safety and efficiency has been used. The man elevator is unique in its application to mines.

The elevator is double-decked and travels in a concrete-lined compartment, about six feet square, of the main west shaft. The counterweight travels in a compartment of the main east shaft (100 feet distant from the main west). The cables of both elevator and counterweight wind on the same drum and are $1\frac{1}{8}$ " in diameter. The elevator is operated electrically from its upper deck, and there can therefore be no confusion of signals. It can, in an emergency, be operated from a stand at the hoist, but not from both places at the same time. Each deck is designed to carry twenty men, but in order to give the operator plenty of room, the number of men carried on the upper deck is restricted to sixteen. Folding steel doors are placed on both open sides of each deck. They occupy very little space when open, and when closed effectually prevent anyone from being crowded against the sides of the shaft. The controller circuit is so arranged that the elevator cannot be started until all of the doors are closed and latched; and should any of the doors be opened while the elevator is in motion, the latter stops at once.

Push buttons are provided at each level and surface landing for calling the elevator. Pushing the button on any level actuates a buzzer and exposes a white mark opposite the number of that level on an annunciator mounted on the upper deck. This is, of course, the same call system as is installed in ordinary passenger elevators. A telephone is also installed at each level, on the upper deck of the elevator, and beside the hoist; and an additional telephone is mounted on the counterweight to facilitate the examination and lubrication of its guides.

As now operated, the elevator travels at a maximum speed of 600 feet per minute. A speed control mechanism, at 10% excess speed, wedges the safety dogs on the elevator against the guides, and the elevator is stopped. The guides are steel "T's" and are bolted to the concrete lining of the compartment.

A number of other safety devices are provided. The limits of travel cannot carelessly be passed by the operator, as a device attached to the drum of the hoist automatically cuts off the current and

throws on the brake when the elevator approaches these limits. The same end is also reached through limit switches placed high on the head frames of elevator and counterweight. Another device stops the hoist should the cable become slack for any reason. A pneumatic cushion in the bottom of the shaft retards the elevator when other devices fail to stop it in time.

This elevator was built and installed by the Otis Elevator Co., of New York.

My team is entered, is yours?

WHO KNOWS HIM?

The only man who does not need Accident Insurance is the man
Who never travels and never enters a carriage, street car, automobile or train;

Who never can have broken bones, bruises, cuts or sprains;

Who cannot drown, fall or be burned;

Whom dogs will not bite, nor horses kick.

And, even at that, lightning may strike him.

Take out a policy in the Bank of Carefulness.

November 14th. That's the date.

CO-OPERATION

In order to have Safety First we must have co-operation of all officials, foremen and workmen.

We want to prevent accidents in our mines and need your help to do it. We want to co-operate with you in this good cause but you must do your part. It is to the interest of your family, yourself and fellow workmen that you be a booster for Safety First. No matter how much interest we take in the movement, no matter how much money we spend; without your co-operation accidents will not be prevented.

Be careful at your work; stop and think before you act. Stop taking chances. It is better to hear your friends say "How do you do" than "How natural he looks."—ARIZONA COPPER CO. BULLETIN.

The C. & A. team is out for blood. Look out!

Many mining companies are providing buildings where the miners may remove soiled working-clothes, bathe, and put on clean, dry cloth-

ing before returning to their homes. Most workmen nowadays like to go to and from their work dry and clean. In many instances miners' cottages have no running water inside and it is a burdensome task to bathe at home. In addition to its cleansing effect, the shower-bath refreshes the tired workman so that he goes home in a more agreeable frame of mind. It is interesting to note that some of the best change-houses are to be found in Michigan, Minnesota, and Alabama, although those states have no law requiring such houses. Some of the earlier change-houses were not kept clean, and so fell into disfavor, their equipment breeding vermin. In some of the earlier buildings a wooden locker was furnished each man. This one locker was used both for street clothes and mine clothes. Because there was no circulation of air in the lockers, the mine clothes would not dry and the miner was forced to put on damp clothes for his day's work. The perforated metal locker has supplanted the wooden locker; and in order to keep the mine clothes separate from the street clothes, two lockers have been furnished each man. The one for street clothes is made of expanded metal, well perforated. The mine-clothes locker is of sheet metal and is as air-tight as possible, except for the vent-pipe at the top. Other lockers have upper and lower compartments, the upper for mine clothes and the lower for street clothes. A steam-pipe is run through the bottom of the upper compartment to furnish heat for drying the mine clothes.—U. S. BUREAU OF MINES, TECHNICAL PAPER NO. 16.

Ray Con. boys have their honors to uphold.

Rich people are smart—that's why they are rich.

They know exactly why they are rich—they can get together, they can agree in both their social and business relations.

Take a room full of poor people and they are quarreling with each other as to why they are poor.

Go to the average socialist, single tax or labor union meeting and they are all so busy hair-splitting and converting one another to individual beliefs that they all remain poor—they never get anywhere.

Rich people even capitalize the desire of others to associate with them.

For instance: A group of rich men will get together and buy lots along a certain street of a city. They will build houses of a certain class, make the street fashionable, sell enough lots to the would-be rich, the boot-lickers and general hangers-on to cover their outlay, live there for a term of years, finally sell out their land for

business purposes for enough to wipe out the cost of their houses and their living expenses in the meantime.

Or, a group of rich people will buy stock in a new city hotel project. They will, as a group, live in this hotel during the first winter of its opening or patronize its cafe. As a result, it is popularized, the stock goes up and their living has cost them nothing.

And there is the same get-together spirit in their industrial, mercantile and banking enterprises.

It is true that rich people are human and they quarrel, but—

Rich people never quarrel in large groups and never over the main issue, and that is why they are rich.

Poor people are always quarreling in large groups over the main issue—which is why they are poor.

Rich people, at least as a class, are clean of body; the places where they congregate do not smell; they shave every day; bathe at least three times a week; those that wear whiskers trim them and comb them occasionally and they never wear coffee-stained mustaches.

Rich people keep their automobiles clean and in repair; they keep their houses painted and grass of their lawns trimmed.

They do not do all these things themselves, but they have force of will or character to see that they are done; for hiring a man and paying doesn't always mean that he does today what he is hired and paid for—everyone that ever had any poor people know this.

Yes, and they perhaps performed all these services themselves till they had money to hire it done.

You never see rich people patronizing five-and-ten-cent stores; for they are smart enough to know that they can get the same things better and as cheap in the basement of any good department store.

You never see rich people taking trading stamps; for, while they may get something for nothing, yet they are smart enough to know that it is never through the medium of trading stamps.

You never see rich people coming home in their automobiles with a 20 cent pot of paper flowers sticking out of their market basket; for they are smart enough to know that they can buy a paper of seeds for five cents or write to their Congressman, for two cents, and have a house or garden full of real flowers in a few weeks.

Nor do you see rich people buy a 40-cent cauliflower at a season when a 10-cent head of cabbage would do them more good.

You never see rich people's dogs eating out of the neighbor's garbage cans and then sleeping with their kids.—THROUGH THE MESHES.

Just watch that D. C. Mexican team work!

WOUNDS MOST SERIOUS IN DRINKERS

The men were 25 to 34 years old.
"Drinkers" were those in whom the
physician detected results of
Chronic Drinking.

I. DAYS OF ILLNESS DUE TO WOUNDS

For every 100 days lost through wounds:

The average man—

Drinkers' class

II. DEATHS DUE TO WOUNDS

Deaths due to wounds in the average man—

Deaths in drinkers' class.

—NATIONAL SAFETY COUNCIL BULLETIN

*The Copper Queen boys are no slouches
either.*

SAFETY FIRST FROM A WOMAN'S POINT OF VIEW

There can be no doubt that the wives, mothers, daughters and sisters of the persons employed by the large corporations of the country are very grateful for the interest which these corporations are showing in the "Safety First" movement, which is being so generally discussed and studied at the present time. It certainly lessens our anxiety to know that every effort is being made to safeguard all employees from accident and to teach them the value of carefulness, and that though an accident does occur, there are men at hand who have been trained to care for the injured, thus lessening suffering and oftentimes saving life.

The safety first movement has gone further than merely installing safeguards and training men in first aid work. In many factories it is leading to the betterment of all working conditions, such as providing good ventilation, good light and healthy, sanitary conditions, in fact it is their aim to improve every condition, which will make for the better health and efficiency of employees.

But are we, the women and home makers of the country, to let our

interest stop at being grateful, can we not do much by co-operation in this movement? Eight hours of the twenty-four is the usual time which the employees spend at the factory, while the other sixteen are spent in the homes or elsewhere. Therefore, should we not make a great effort in seeing that all conditions of the home and community, which pertain to the health and safety of its occupants, are bettered, if possible.

By glancing over almost any daily paper, we can readily see that a great per cent of all accidents happen in the home,—this is especially true in the case of children under school age, and practically all such accidents are the result of neglect or careless practice. Therefore, should not we, as well as the heads of factories, railroads, etc., give study to this subject?

Of course some accidents in and about the home would seem to be unavoidable, but here we have the opportunity to accomplish much, if we have some knowledge of first aid work. Few mothers know how to properly dress or bandage a wound or the right method of helping or handling an injured person, therefore, would it not seem timely that we, as wives and mothers, make an effort to co-operate in this movement, and in some way to become familiar with the teachings of "Safety First" and the "Practice of First Aid?"—
BY THE WIFE OF AN EMPLOYEE OF THE B. & M. REDUCTION DEPT.

The O. D. boys have a good leader and have been working hard.

HOW SAFETY PAYS

"Safety pays" is a term one frequently hears. It *pays* in that it lessens enormously the sum of human suffering—physical and mental. The United States Government reports that where attention to safety and health is a definite form of organization, two accidents out of three are avoided; and one of our members—the United States Steel Corporation—finds that through its systematic effort for safeguarding the lives and health of its employees since the activities of its Bureau of Safety began, more than 11,000 lives have been saved, which lives, had the same conditions existed as before the inauguration of this movement, would have been sacrificed as a part of the cost of one of our great industries. Safety *pays* in the sense that the most dangerous industries can be made safe; the theory of the specially hazardous industry, or the assumption of risk, in which life and health are the toll, ceases to exist; furthermore, it *pays* in the sense that men

and women work faster and better and, therefore, more efficiently and economically in their respective fields of activity; it *pays* in that accident costs are lessened and sometimes eliminated; in that, through employees noting consideration for their welfare, better relations are developed with their employers, and employers concerned in the matters develop a more kindly feeling toward their employees; it *pays* society as a whole in that fewer men and women are sick, injured or killed, eliminating such serious direct and indirect human losses and the resulting social evils.—SAFETY.

Come with your banner and your flag.

SAFETY WORK AT THE NEW JERSEY ZINC CO.

Unlike factories and other industrial establishments which have their greatest risks from moving machinery, the metal mines suffer greatly from risks such as "falls of ground," "handling explosives," "the loading of cars from chutes and subsequent tramping," etc., in which the supervision and the education of the workman are absolutely necessary for his safety, since no mechanical contrivances can protect him. With the realization that any marked reduction in the number of mining accidents, and consequent loss of time to the workmen and loss of more or less experienced labor to the company, would probably be attained by the education of the workmen in taking an intelligent interest in their own safety and that of co-workers, the New Jersey Zinc Co., in its mines at Franklin Furnace, N. J., departed this year from its former system of looking entirely to the foremen and bosses for safety and first aid work, and instituted a plan which seems to stimulate the interest of both the bosses and men.

*Good rooters add much to a team's chances
for victory.*

WELFARE WORK OF THE CALUMET & HECLA.

Probably no mining company in the country has paid more attention to the welfare work than has the Calumet & Hecla Mining Company, and its subsidiaries, in the upper Michigan peninsula. Its work has not alone been confined to safety and rescue work, but general welfare work, and its activities have been along the line of general care of its men and their families and the community in general.

The Calumet & Hecla aid fund was organized in 1877 to provide help for the company employees in case of sickness, accidents or death. The rules provided that every man desiring to accept benefit from the fund should be charged 50 cents per month through the mining office, and every boy whose wages were under \$50 per month should be charged 25 cents. To the amount thus collected the company added a similar amount. A contributor disabled by reason of an accident was to receive from the fund \$25 per month or fractional part thereof.

From July 1, 1877 to Jan. 1, 1913, the men contributed a total of \$504,881, and the amount added by the company was \$625,483. The total disbursements to members were \$1,596,707. The excess of disbursements over contributions was due to the fact that some of the surplus in the early days was invested in Calumet & Hecla stock, and the dividends accrued to the credit of the fund.

Beginning in 1897 there was a period of 40 months in which no collections were made from the men, but during this time the company paid into the treasury the same as would have been paid by both men and company if the former had contributed. When collections from the men started again, the amount was raised $2\frac{1}{2}$ per cent in order to take care of the lack of contributions. No contributions were made by the men after Jan. 1, 1913, as the surplus was of sufficient size to take care of itself. On Jan. 1, 1914, the balance was \$76,934.

In the fall of 1912 the new Michigan compensation law came into effect, and the rules of the aid fund were changed to provide for payment therefrom only in case of sickness, the compensation fund taking care of accidents. All kinds of sickness were included, whether or not connected with the occupation of the employee. There was, furthermore, a contribution entirely outside of the aid fund, made by the mining company in case of death from sickness not connected with the miner's occupation. This contribution amounted to from \$200 to \$250 and the practice of making it has been followed from the time the rules of the aid fund were changed.

The fund is administered by a committee of five, of which the mining company appoints two and the men elect three, the elections being made by ballot. At the Calumet & Hecla, Mr. Know, the general superintendent, together with the company's head physician, represent the company on the administrative board. Under the old rules the mining captain, the head physician and a miner were selected to administer the fund. This only applies to the Calumet & Hecla Company itself, there being a difference between it and its

subsidiary companies in the fact that with the subsidiary companies, the companies do not contribute. The system of administration is the same, however.

You'll be there!

WHAT OTHERS ARE DOING

An article occurring in the public print from the prominent safety engineer, Charles W. Goodale, Chairman of the Bureau of Safety of the Anaconda Copper Mining Co., from which we take the liberty of quoting, states:

"Beginning several years ago, the larger corporations all over the United States have been making organized efforts to reduce the number of accidents in their factories, works and mines.

"The first move of the employer has been to form a Bureau of Safety, and committees have been selected under the following general plan:

"1. A central committee made up of the executive officers and heads of departments.

"2. Sub-committees with the heads of departments as chairmen, and their foremen acting with them.

"3. Committees selected from the rank and file of the men.

"Sometimes the last two are combined, a few of the men being selected to serve on the sub-committees for a limited time, when their places are taken by a new selection, and thus the whole organization gradually becomes permeated with the principles of 'Safety First.'

"The first work of the committees is to make a careful study of the causes of all accidents, with a view to attacking these causes in a systematic way. Records are kept of meetings of the committees, and all suggestions looking to safer and better conditions are noted. Accidents which have occurred since the previous meeting are brought under review, and ways of avoiding them in the future are discussed.

"In some cases books containing rules and cautions have been prepared by the committees for general distribution among all employees, while at other mines, smelters and works these rules and notices have been posted on bulletin boards.

"Many employers are members of the National Safety Council, the American Museum of Safety, the American Mine Safety Association, and other similar organizations, whose exhibits are freely used on bulletin boards.

"The committees have placed danger signs wherever needed, and all effective safeguards are adopted.

"Some of the companies are publishing weekly or monthly magazines devoted to accident records and prevention, and efforts are made to develop friendly rivalries between different mines and departments in reducing the number of accidents.

"In one of the large plants of this state a careful study of all accidents, before the establishment of a bureau of safety, showed that not over 15% of the cases could have been prevented by any safeguard installed by the employer. From this it is evident that while the safety movement is gathering strength every day, a reduction of accidents to the minimum can only be accomplished when all workers have acquired the Safety Habit."

The report of Mr. F. M. Metcalfe, head of the Northern Pacific Bureau of Efficiency and Safety First, states that during the past year accidents have decreased 25 per cent among the employees of the company.

The Great Northern reports a similar gratifying condition.

The reports covering accidents for the first half of the present year occurring among railroad employees throughout the entire length and breadth of the 250,000 miles of road operated, showed a remarkable decrease in accidents as compared with any previous six months. This is the second half, in succession, that the railroads have broken the record in accidents. The reason assigned for the continued and rapid decrease in the happening of accidents is the acquiring of the Safety First habit.

The Anaconda Copper Mining Co. also report a substantial and gratifying decrease in accidents in all branches of their operations.

Mr. Frank Smith, Manager of the East Helena plant of the American Smelting & Refining Co., reports that through the Safety First movement, accidents in their plant have been reduced 50 per cent and that the past month (September) shows a 98 per cent reduction.—(REPT. MONT. IND. ACCIDENT BOARD.)

Sure I will.

INDUSTRIAL

Safety First does not mean safety in the mine and about the works only, but means safety at home. The Powerlight Manufacturing Co. of 543 Broadway, N. Y., are putting out a safety device for the home, a non-explodable lamp giving exceptionally bright light. The Powerlight, illustrated below, was awarded the Gold Medal at the National Exposition of Safety and Sanitation.



November 14th. Phoenix.



Bulletin No. 39

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Bulletin

The Selling of Lead and Zinc

BY

H. J. STANDER



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METALLURGICAL SERIES No. 3.

NOVEMBER 7, 1916

THE SELLING OF LEAD AND ZINC

By H. J. STANDER.

THE SELLING OF LEAD.

The lead industry in 1915 made good gains in output, both in mining and smelting. The lead content of ore mined in the United States was apparently over 600,000 short tons, compared with 522,864 tons in 1914, an increase of 78,000 tons, or 15 per cent. With the higher prices prevailing the percentage of increase in value of the 1915 output was even greater as compared with other years.

During 1915 construction was begun on one lead smelter and plans were completed for another, both to treat ore from the Coeur d'Alene district of Idaho. The Hercules Mining Co. purchased the copper smelter at Northport, Wash., and began the construction of two lead furnaces. This company is affiliated with the Pennsylvania Smelting Co. of Pittsburgh, Pa. The Bunker Hill & Sullivan Co. of the Coeur d'Alene district also completed plans for a smelter, but the site is yet in abeyance. The National refinery of the American Smelting & Refining Co. at Chicago, was dismantled, and the Balbach Smelting & Refining Co. abandoned its older lead plant at Newark, N. J.

The following estimates have been compiled by C. E. Siebenthal from reports to the United States Geological Survey by all the lead refineries and soft-lead smelters in operation during the year, except two smelters in the Joplin district, for which estimates have been made. These reports cover actual production for the first 10 or 11 months of the year, with an estimate for the remainder of the year, and from them the figures of production are made up without change. The statistics of imports, exports, and lead remaining in warehouse have been taken from the records of the Bureau of Foreign and Domestic Commerce for 10 months, the figures for November and December having been estimated.

LARGEST PRODUCTION TO DATE.

The production of refined lead, desilverized and soft, from domestic and foreign ores in 1915 was approximately 565,000 short tons, worth at the average New York price \$53,110,000, compared with 542,122 tons, worth \$42,285,500, in 1914, and with 462,460 tons in 1913. The figures for 1915 do not include an estimated output of 20,550

tons of antimonial lead, worth \$1,886,000, against 16,667 tons in 1914, and 16,665 tons in 1913. Of the total production, desilverized lead of domestic origin, exclusive of desilverized soft lead, is estimated at 306,682 tons, against 311,069 tons in 1914 and 250,578 tons in 1913; and desilverized lead of foreign origin at 48,318 tons, compared with 29,328 tons in 1914 and 50,582 tons in 1913. The production of soft lead, mainly from Mississippi Valley ores, is estimated at 210,000 tons, compared with 201,725 tons in 1914 and 161,300 tons in 1913. The total production of lead, desilverized and soft, from domestic ores, was thus about 516,682 tons, compared with 512,794 tons in 1914.

The final figures for the production of soft lead will show an increase of a few thousand tons over those here given, for the reason that the smelters and refiners of argentiferous lead undoubtedly treated more or less soft lead from the Mississippi Valley which is not distinguished from silver-lead ores in their preliminary estimates.

IMPORTS AND EXPORTS.

The imports of lead are estimated at 9,625 short tons of lead in ore, valued at \$653,000; 50,825 tons of lead in base bullion, valued at \$3,496,000; and 400 tons of refined and old lead, valued at \$28,000—a total of 60,850 tons, valued at \$4,177,000, compared with 28,338 tons in 1914. Of the imports in 1915 about 58,000 tons came from Mexico, against 23,141 tons in 1914. These imports from Mexico are to be compared with an average of over 100,000 tons before the civil strife in that country. The remaining imports of lead came mostly from Chile.

The exports of lead of foreign origin smelted or refined in the United States again show an increase, being estimated at 43,000 tons, against 31,051 tons in 1914 and 54,301 tons in 1913. For the last two years, on the other hand, notable quantities of domestic lead have been exported to Europe, and the total for 1915 is estimated at 76,000 short tons, valued at \$6,650,000, compared to 58,722 tons, valued at \$4,501,674, in 1914.

LEAD AVAILABLE FOR CONSUMPTION.

The amount of lead available for consumption during 1915 may be estimated by adding to the stock of foreign lead (domestic stocks are not known) in bonded warehouses at the beginning of the year (7,668 short tons) the imports (about 60,850 tons), the additions by liquidation (1,795 tons), and the domestic production (516,682 tons, making an apparent supply of 587,000 tons. From this are to be subtracted the exports of foreign lead (about 43,000 tons), the exports of domestic lead (76,000 tons), and the stock in bonded warehouses

at the close of the year (assumed to be the same as at the close of October, 16,000 tons), leaving as available for consumption 452,000 tons, compared with 449,052 tons in 1914.

HIGH PRICES.

Lead began the year at New York with a price of 3.8 cents a pound, nearly the minimum price of the year, and remained practically stationary until the middle of February. A gradual rise brought the price to 4.2 cents in April, and it remained there until the later part of May. A rapid rise next followed, and lead reached the maximum for the year at 7.56 on June 14. A sharp decline, followed by partial recovery and then by a more general decline, brought the price to 4.4 cents in the later part of August. After a slight recovery and another decline to 4.45 cents in September, the price gradually rose and closed the year at about 5.4 cents. The average New York price for the year was 4.7 cents a pound, compared with 3.9 cents in 1914 and 4.4 cents in 1913.

The London price of lead started at £19 a long ton (4.1 cents a pound) and rose until the latter part of March, when it reached £23 2s. 6d. a long ton (5 cents a pound). From this point the price fell to £20 1s. 3d. a long ton (4.3 cents a pound), after which there was a sharp ascent to £28 2s. 6d. (6.1 cents a pound) at the middle of June. After several ups and downs the price dropped to £20 6s. 3d. (4.4 cents a pound) by the middle of August, and then a gradual rise carried it to £29 5s. a long ton (6.3 cents a pound), and it closed the year at about that figure. The London market was fairly parallel to the New York market and, except for the period of high prices in the United States during July and August, was uniformly higher than the American market.

There are three forms of commercial lead:

1. The ordinary refined lead.
2. Corroding lead. This is especially pure.
3. Antimonial lead. This last kind of lead contains about 17 per cent of antimony, and is largely used in type metal.

The two lead markets in the United States are New York and St. Louis, and the difference in the prices quoted from these two places will, of course, be the freight rate, i. e., about 15 cents per hundred pounds.

PENALTIES.

As in the case of copper ores, there is a penalty for each of the following substances found in excess in a lead ore: zinc, arsenic and antimony; but besides this there is also a penalty on sulphur content greater than 3 per cent, and the penalty is usually 20 cents per unit

above 3 per cent of sulphur content. The reason for this is that while sulphur is necessary for the smelting of copper, it is not at all necessary in lead smelting. When there is a large amount of sulphur in a lead ore, it becomes necessary to first roast the ore before it can be smelted, and this, of course, costs considerably. Thus a smelter will allow usually only 3% of sulphur in a lead ore, as such a small quantity of copper can be gotten rid of in the smelting process, without going to the expense of first roasting the ore.

The proportion of lead in an ore or concentrate can be determined in one of two ways:

1. Wet analysis. By this means one gets what is commonly called the "wet lead," and the results of a wet analysis on a lead ore usually represents the actual amount of lead present.

2. Fire assay. This is the older of the two methods, and really gives the amount of lead in the ore as will be obtained in the actual smelting process.

One will usually find that the results obtained from a wet analysis are about 0.7 per cent higher than those obtained from a fire assay determination, when the ore does not contain any appreciable amounts of easily reducible metals, such as copper, antimony, bismuth, arsenic and zinc. When, however, the ore is fairly "impure," i. e. it contains an appreciable amount of the above-mentioned metals, some of these metals are reduced with the lead, in the case of a fire assay. The quantity of lead then obtained will be too high, as it will have in it whatever amount of these metals that has been reduced, so that the results may be fairly incorrect. Thus when a smelter buys lead ore that contains a large amount of such easily reducible metals, it always wishes to do so on the basis of the wet analysis, because the amount of lead present, as given by this method, will then be less than that obtained by a fire assay. But in the case of a "pure" ore, the fire assay gives the lower figures for the percentage of lead in the ore, and in the case of the "pure" lead ores, one can see that the smelter will always be desirous of buying the ore on the fire assay basis, whereas the seller's attitude in this matter, will, of course, be just the opposite from that of the smelter.

The following method for determining the percentage of lead in the ore is the one in common use now, in order to overcome the difficulties arising from the different results as obtained from wet analysis and fire assay determinations in the case of different kinds of lead ores.

1. **Pure Lead Ores.** The fire assay method, although both buyer and seller can get checks on the fire assay figures from wet analyses.

2. **Other Lead Ores.** (a) Fire assay, but the lead in the button is determined by wet analysis. (b) Wet analysis, with a deduction of from 1 to 1.5 per cent.

The smelter usually pays only for 90 per cent of the lead content, determined either by the fire assay or wet analysis, less about 1.5 per cent, which is usually called "the dry analysis basis." The smelter pays only for 90 per cent of the lead content because of such a great amount of smelter losses that always take place in the case of lead smelting. These losses amount to from 5 to 15 per cent of the lead smelted, and the losses in the case of a high grade ore are always relatively less than those in the case of a low grade lead ore.

NEUTRAL SCHEDULE ON LEAD IN LEAD ORES AND LEAD-COPPER ORES.

Lead Content	Value per Unit	Smelter Charge per Ton
5 to 10%	40 cents	\$6.00
10 to 15%	43 cents	5.00
15 to 20%	45 cents	4.00
20 to 25%	47 cents	3.00
25 to 30%	49 cents	3.00
30 to 35%	51 cents	2.00
35 to 40%	52 cents	1.50
40 to 45%	52 cents	1.00
45 to 50%	53 cents	1.00
50 to 55%	54 cents	1.00
Over 55%	55 cents	1.00

FLAT SCHEDULE ON LEAD IN LEAD ORES AND LEAD-COPPER ORES.

Lead Content	Value per Unit	Smelter Charge per Ton
5 to 10%	40 cents	\$10.00
10 to 15%	43 cents	8.50
15 to 20%	45 cents	7.00
20 to 25%	47 cents	5.50
25 to 30%	49 cents	4.50
30 to 35%	51 cents	3.50
35 to 40%	52 cents	2.00
40 to 45%	52 cents	1.00
45 to 50%	53 cents	1.00
50 to 55%	54 cents	1.00
Over 55%	55 cents	1.00

SCHEDULE ON LEAD CONCENTRATES.

Lead Content	Value per Unit	Smelter Charge per Ton
5 to 10%	40 cents	\$3.75
10 to 15%	43 cents	3.00
15 to 20%	45 cents	2.50
20 to 25%	47 cents	2.25
25 to 30%	49 cents	2.75

In all cases, the following is usually the schedule on which payment for gold, silver and copper in the lead ores:

Gold, \$19.50 per ounce, if 0.05 ounce or over per ton.

Silver, 95% of contents at New York quotation, date of assay.

Copper, for dry copper (1.5% off wet) and 6 cents off per pound on Western Union quotation for casting copper.

The payment for the amount of lead in the ore is made in one of three different methods: They are:

1. By the unit and at quotation.
2. For 90% of lead content at the sales price, with a deduction per pound.
3. For 90% of lead content at 90 or 95% of the sale price.

The price per unit is based on a quotation of \$4 per 100 pounds of lead. For every rise of 5 cents in the quotation, 1 cent is added to the price per unit, and in the same way, 1 cent is deducted from the price per unit for every fall of 5 cents in the quotation.

One must remember that the quotation is not the sales price in New York, but is 90% of this price. So that when the New York sales price is \$4 per 100 pounds, the quotation is 90% of \$4, i.e. \$3.60. When, however, the sales price is below \$4.50 and over \$4.00, the quotation is obtained by taking 90% of the \$4 sales price, and adding to it one-half of the excess of the sales price over \$4. Again, when the sales price is above \$4.50, the quotation is 90% of \$4, i. e. \$3.60, plus one-half the excess of the sales price between \$4 and \$4.50, plus the excess above \$4.50.

Usually no payment is made for a lead content of less than 5% in an ore. Sometimes, however, a bonus of 15 cents per unit is given for lead in an ore, if the lead content is below 5%. Since the losses are comparatively greater in smelting low grade ores than in smelting high grade ores, the smelter usually pays a lower price per unit for the lead in low-grade lead ores than for the lead in high grade ores.

SELLING OF ZINC.

The common term for commercial zinc is spelter. All the great zinc fields and a great number of the zinc smelters are situated in Missouri and not far from St. Louis; for this reason, St. Louis, Mo.,

is the main zinc market. It is, however, also sold in New York, but on a St. Louis basis.

It is essential in the case of zinc that the ore be of a high grade character, because too low grade zinc ores cannot be treated at the zinc smelter directly. In the United States zinc is chiefly produced in Missouri, Wisconsin, Colorado and Montana. Bids are always made in the open market, and smelters usually have representatives who offer prices for given lots of ore. There are two standard zinc ores:

1. The 60% ore, which is commonly zinc sulphide, or what is called "blende."
2. The 30% ore, which is zinc silicate, or calomine.

PENALTIES.

Lead is sometimes penalized when present in a proportion above 0.5%; iron, when present over 1%, is penalized at the rate of \$1 for each one per cent above this figure.

The New York price for zinc is the price quoted at St. Louis, plus 15 cents per hundred pounds, which is the freight rate on spelter from St. Louis to New York. Spelter is protected by an import duty of 15 per cent ad valorem, and the zinc ore by a duty of 10 per cent ad valorem.

The Engineering & Mining Journal, Jan. 10, 1915, published the accompanying table, giving the names and capacity of the zinc smelters in the United States. Their capacity is calculated from the number of retorts at the end of 1914.

Name of Plant.	Situation	No. of Retorts
Altoona Zinc Smelting Co.	Altoona, Kans.	3,845
American Zinc & Chemical Co.	Longcloth, Pa.	864
American Zinc Co. of Illinois	Hillsboro, Ill.	400
American Zinc, Lead & Smelting Co.	Dearing, Kans.	3,840
American Zinc, Lead & Smelting Co.	Caney, Kans.	3,648
Barblesville Zinc Co.	Barblesville, Okla.	5,184
Barblesville Zinc Co.	Collinsville, Okla.	8,064
Channbe Zinc Co.	Channbe, Kans.	1,780
Clarksburg Zinc Co.	Clarksburg, W. Va.	2,712
Collinsville Zinc Smelting Co.	Collinsville, Ill.	1,536
Edger Zinc Co.	St. Louis, Mo.	1,180
Edger Zinc Co.	Cherryville, Kans.	4,800
Granby Mining & Smelting Co.	Neodeska, Kans.	3,840
Granby Mining & Smelting Co.	E. St. Louis, Ill.	3,240

Grasselli Chemical Co.	Clarksburg, W. Va.	12,672
Grasselli Chemical Co.	Meadowbrook, W. Va.	
Hegeler Bros.	Danville, Ill.	1,800
Illinois Zinc Co.	Peru, Ill.	4,640
La Harpe Spelter Co.	Le Harpe, Kans.	1,856
Robert Lanyon Zinc & Acid Co.	Hillsboro, Ill.	1,840
Layone Starr Smelting Co.	Barblesville, Okla.	3,456
Matthiesen & Hegler Zinc Co.	La Salle, Ill.	5,256
Mineral Point Zinc Co.	Depue, Ill.	9,080
National Zinc Co.	Barblesville, Okla.	4,260
National Zinc Co.	Springfield, Ill.	3,200
Nevada Zinc Co.	Nevada, Mo.	3,648
New Jersey Zinc Co.	Palmerton, Pa.	5,760
Pittsburg Zinc Co.	Pittsburg, Kans.	910
Prime Wesborn Spelter Co.	Gas City, Kans.	4,768
Sandoval Zinc Co.	Sandoval, Ill.	6,896
Tulsa Fuel & Manufacturing Co.	Collinsville, Okla.	4,232
Tulsa Spelter Co.	Sand Springs, Okla.	4,000
United States Zinc Co.	Pueblo, Colo.	1,920
Total		120,994

There are four kinds of spelter on the market:

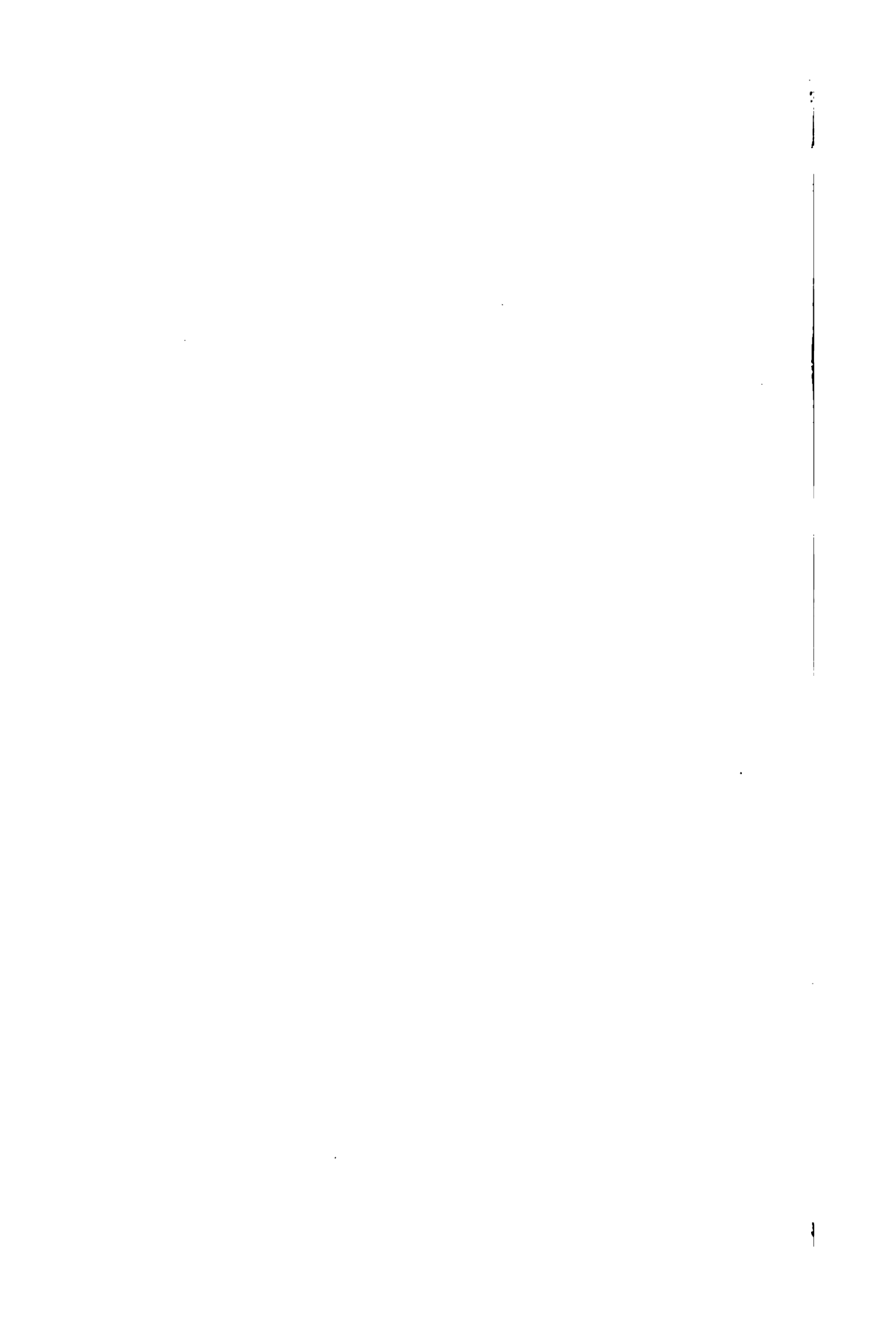
	% Lead	% Iron	% Cu	% Impurities
I. High grade or A	0.07	0.03	0.05	0.10
II. Intermediate or B	0.70	0.03	0.05	0.50
III. Brass Special or C	0.75	0.04	0.07	1.20
IV. Prime Western or D	1.50	0.08	....	....

The high grade spelter is usually from 2 to 4 cents per pound more than that of the prime Western; intermediate spelter is from 1 to 2 cents more per pound than prime Western. The prime Western is used chiefly for galvanizing iron, steel wire and iron flake.

The total production of spelter by ore smelters in 1914 was 362,361 tons, and there was a larger exportation of spelter than ever before in the history of the United States, the total being 70,242 tons, including 5,580 tons of spelter smelted in bond. These figures are from the "Mineral Industry" of 1914.

In conclusion, it may be worth while to give an example of a schedule of smelter charges for treatment of all classes of ore. The following schedule is typical of some of those in force in the western sections of the United States:

Gross Value Per Ton of Ore	Treatment Charges Per Dry Ton
Under \$14	\$ 5.00
\$14 to \$20	6.00
\$20 to \$25	6.50
\$25 to \$30	7.00
\$30 to \$35	7.50
\$35 to \$40	8.00
\$40 to \$45	8.50
\$45 to \$50	9.00
\$50 or over	10.00



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Economic Series No. 10

University of Arizona Bulletin

Building Stones

BY

F. L. CULIN, JR.



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University of Arizona Bulletin

ECONOMIC SERIES No. 10

NOVEMBER 14, 1916

BUILDING STONES

BY FRANK L. CULIN, JR.

Introduction:—The term "building stone" includes all stones for ordinary masonry construction, as well as for ornamentation, roofing, and flagging. A very wide variety of stones is used for this purpose, including practically all varieties of igneous, sedimentary and metamorphic rocks. There are a few, however, which are more commonly used than others, because of their widespread occurrence and durability. The color of a building stone quite often gives it a popularity which determines, to a large degree, the extent of its use. New England brownstone is probably the best example of this.

The growth of the brick industry and also of the cement industry has opened a severe competition with building stones. Brick and concrete blocks being cheaper, are widely used in many sections of the country. Solid concrete, in many cases, has replaced stone for not only super-structures but sub-structures as well. However, there is still a very great demand for high class building stones and probably always will be.

Types of Building Stones:—The stones most desired for structural purposes are:

1. Granites.
2. Limestones and marbles.
3. Sandstones.
4. Slates.
5. Serpentine.

Description:—The term "granite," as used by quarrymen and contractors, usually includes all igneous rocks, gneisses and often schists. A true granite is an entirely crystalline, deep seated, igneous rock, consisting of quartz, orthoclase feldspar and either mica, hornblende or augite, or all of the last three minerals. Other varieties of feldspar may be present in varying amounts, as well as various accessory minerals, such as pyrite, garnet, tourmaline, epidote and many others.

Texture:—Granites vary in texture from fine to coarse grained. and in some cases are porphyritic. They pass into gneisses by such insensible gradations that it is difficult, if possible at all, to draw a sharp line of distinction between the two.

Color:—Variable, most commonly gray, mottled gray, red, pink, white or green, according to the color and abundance of the component minerals. The color is usually, though not always, permanent.

Weight and Hardness:—The average specific gravity of granites is 2.65, or about 165.5 pounds per cubic foot. Usually quite hard.

Porosity:—Commonly contain less than 1% of water, but will absorb from 2 to 3% more.

Crushing Strength:—Variable: lies between 15,000 and 30,000 pounds per square inch.

Occurrence:—Granite usually occurs in batholithic masses, sometimes forming the cones of mountain chains. Is exposed by erosion. Shows a very wide geologic range, but is usually associated with older formations.

Determining Characteristics:—Granites may be recognized by their holo-crystalline structure, and by their composition—quartz and feldspar in, usually, almost equal amounts, with smaller amounts of mica, hornblende or augite, and accessory minerals.

LIMESTONES AND MARBLES.

The term "limestone and marble" includes a great series of sedimentary and metamorphic rocks, composed chiefly of carbonate of lime with various impurities. Dolomite contains lime and magnesia. Sedimentary limestones may contain varying amounts of iron oxide or carbonate, silica, clay, and carbonaceous matter. When of metamorphic origin, various silicates, such as mica, hornblende, pyroxene, etc., may be present.

Texture:—These rocks vary in texture from fine grained, earthy, to coarse grained, fossiliferous rocks, and from fine to coarsely crystalline varieties.

Color:—There is also a great range in color, the most common being blue, gray, white and black, also yellow, red, pink and green. The color is largely due to impurities, usually iron oxides.

Weight and Hardness:—An average specific gravity for limestone is probably 2.5—or about 150 to 160 pounds per cubic foot. Limestones are quite soft, being readily scratched by a knife.

Crystalline varieties are much harder.

Porosity:—Absorption of water is generally very low.

Crushing Strength:—Varies from 10,000 to 15,000 pounds per square inch.

Varieties and Occurrence:—Geologically speaking, limestones are of sedimentary origin, while marbles and dolomites are metamorphic. In the trade, however, a marble is any calcareous rock that will take

a polish. Besides marbles and straight limestones, the following varieties are recognized:

1. *Chalk*—A fine white earthy limestone composed of fossil remains.
2. *Coquina*—Loosely cemented shell aggregate.
3. Dolomite or dolomitic limestone—composed of carbonate of lime and magnesia.
4. Fossiliferous limestones—those lime rocks which contain an abundance of fossils.
5. Hydraulic limestone—limestone with over 10% of clayey impurities.
6. Lithographic limestone—an exceedingly fine grained, crystalline limestone. Not used for structural work.
7. Oolitic limestone—composed of small rounded concretionary grains.
8. Stalactitic or stalagmitic deposits—found in the roofs and floors of caves respectively. Often of crystalline texture and beautifully colored. When of sufficient size and solidity known as onyx marble.
9. Travertine or calcareous tufa—limestone deposited from springs—often sufficiently hard and durable for building, but rarely occurs in deposits of large size.

Structural limestones usually occur in beds or lenses; sometimes, in the case of onyx marbles, as cave deposits; rarely, as spring deposits. They are very widespread, and are found in practically all the geological ages.

Tests:—The best field test for limestone is its effervescence with hydrochloric acid, combined with the softness. The various varieties are recognized best by their color and structure.

SANDSTONES.

Most sandstones are composed of quartz grains, but some varieties contain an abundance of other minerals, such as mica, or, more rarely, feldspar. Pyrite is sometimes present, and clay often occurs in sufficient quantity to influence the hardness and dressing quality of the stone. The cement holding together the grains is siliceous or ferruginous in good building stone, but may be calcareous or carbonaceous, or a compound of various substances. Thus the chemical composition has a wide range, from nearly pure silica to sandstone with a large percentage of other compounds.

Texture:—Sandstones vary from very fine to coarse grained. They may be very hard, or quite soft and crumbly, depending upon the character of the cementing material.

Color:—The most common colors for sandstones are light gray, white, brown, bluish gray, red and yellow.

Weight and Hardness:—The average specific gravity of sandstones is about 2.7, so that a cubic foot weighs about 160 to 170 pounds. In hardness they vary from quite hard in highly siliceous varieties to softer in other kinds.

Porosity:—Highly siliceous sandstones are usually nearly impervious, but the absorption of other varieties is variable.

Crushing Strength:—Very uncertain—the variation has an extremely wide range due to variable composition.

Occurrence:—Sandstones occur as beds and lenses.

Tests:—Sandstone is easily recognized by its structure. Siliceous sandstone is recognized by its hardness; ferruginous sandstone, by its color; calcareous sandstone by its effervescence with acid, and its relative softness.

SLATES.

Slates are metamorphic rocks derived from clay or shale and rarely, from igneous rocks. The composition is quite variable, due to metamorphism—silicates of iron, aluminum and magnesium are probably most common. Carbonaceous matter is often present.

Texture:—Slates are usually very fine grained. They possess a well defined plane of spitting, or cleavage, developed by pressure and the development of micaceous minerals.

Color:—The presence of carbonaceous matter colors most slates black or bluish black, but green, purple, and red slates are also found.

Weight and Hardness:—The specific gravity of slate is about 2.7, and a cubic foot weighs between 170 and 175 pounds. Slates are not very hard—they can be scratched by a knife.

Porosity:—The porosity of most slates is very low.

Crushing Strength:—The crushing strength of slates is usually given at from 3,000 to 10,000 pounds per square inch. It is rather uncertain.

Occurrence:—Slates occur as beds and lenses.

Tests:—Slates are readily recognized by the pronounced cleavage, and also by the color.

SERPENTINES.

Pure serpentine is a hydrous silicate of magnesia; but beds of serpentine are rarely pure, usually containing varying quantities of such impurities as iron oxides, pyrite, hornblende, and carbonates of lime and magnesia.

Texture:—Crystalline in structure, but usually massive, sometimes foliated, also fibrous. At times slaty.

Color:—When pure, green or greenish yellow; impure varieties various shades of black, red and brown. Also spotted in various combinations, green and white being most common. Changes color on exposure.

Weight and Hardness:—Weight is variable, from 2.2 to 2.65 specific gravity; or from about 137 to 165 pounds per cubic foot. Usually quite soft (2.5 to 4) but in some crustals up to 5.5 (rare).

Porosity:—Usually very low.

Crushing Strength:—Very low, as a general rule.

Occurrence:—Serpentine is always a secondary mineral, resulting from the alteration of silicates containing magnesia. It occurs as large rock masses, and as irregular veins or lenses.

Tests:—Has a smooth, rather greasy feel. In closed tube yields water. Before blowpipe fuses on edges with difficulty. Usually gives an iron reaction. Is decomposed by hydrochloric and sulphuric acids.

USES OF BUILDING STONES.

Building stones are used for structural work of various kinds—the stone to be used depending largely, in most cases, on its nearness to the market.

Because of its massiveness and durability, granite is much employed for massive masonry construction. Some varieties that take and preserve a high polish are much more used for ornamental and monumental purposes. Due to its greater durability, granite is largely replacing marble for monumental work. The refuse of granite quarries is often made into paving blocks or crushed for roads and railroad ballast.

Limestones are used mainly for ordinary dimension blocks, although in some cases it is suitable for carving. The quarry refuse is often used for road material, lime, or for Portland cement. The use of marble for structural work has been increasing. It is much used for monumental work, and also for interior decorations, as wainscoting, paneling, sometimes flooring, and table tops.

Due to their wide distribution, sandstones are an important source of local structural material. They are chiefly used for ordinary building work, and but little for masonry or monuments. The thin bedded varieties are much used for flagging, and some of the harder sandstones are made up into paving blocks. Sandstones are also used as abrasives, but that is apart from our purpose.

Slate is most widely known as roofing material, but it is also used for mantles, billiard table tops, floor tiles, steps, flagging, slate boards

and pencils, acid towers, washtubs, etc. There is much waste in quarrying slate. This refuse is sometimes used for paints, and in the manufacture of brick and Portland cement.

Serpentines are largely used for interior decorations, due to their uneven weathering, when exposed.

METHODS OF MINING AND PREPARATION.

Practically all building stones are obtained by quarrying. The rocks may be cut out of the deposits by saws or channeling machines, or it may be blasted out, depending on bedding planes and later dressing to obtain blocks of proper size.

In preparing building stones for market, they are usually cut to some special size or shape, as cubical or oblong blocks, panels, tiles, flagging, and other shapes. The stones are shaped by means of saws, or by chipping.

THE BUILDING STONE INDUSTRY.

The production of granite, marble, limestone, and sandstone for building purposes in 1913 amounted to about \$18,000,000, a decrease in value of about \$200,000 over 1912. No figures later than 1913 are available, and no figures for slate can be found.

GRANITE.

About 32% of the value of the total granite output is used for building stone, amounting to \$6,661,415 in 1913, as compared with \$6,125,841 in 1912. The production of granite for building stone is therefore about 40% of the entire building stone output.

Vermont produces most of the granite used for building stone, followed by Massachusetts, Maine and New Hampshire. The production of these states is mostly dressed stone. Pennsylvania produces most of the rough granite.

The value of the dressed granite production was \$5,369,179, and of the rough stone was \$1,292,236.

MARBLE.

The values for marble production include also the value of serpentine and onyx marble. The total value of the marble production for 1913 was \$7,870,890, of which 63.3% was used for building purposes, representing a value of \$4,892,462. The value of marble used for exterior building work was \$1,822,214, as compared with \$2,771,645 in 1912. The 1913 production was divided

as follows: \$993,214 for rough and \$829,244 for dressed building stone. The total value of marble used for interior decoration work in 1913 was \$3,160,005, a gain of \$1,215,844 over 1912, when the value amounted to \$1,944,161.

The commercial output of marble came from Vermont (44.64%), Tennessee (18%) and Georgia (14%). Other states producing were Colorado, Alabama, Massachusetts, New York, Pennsylvania, Alaska, California, Maryland, North Carolina, Utah, Arkansas, New Mexico, Washington, Virginia and Oregon.

LIMESTONE.

The total production of limestone in 1913 had a value of \$38,745,429, as compared with \$36,729,800 in 1912. About 11% of this value is represented by building stone, or \$4,509,339 in 1913, as compared with \$5,051,896 in 1912, a decrease of \$542,557. The production of rough building stone had a value of \$1,943,064, and of the dressed stone, \$2,566,275.

Indiana and Missouri are the largest producers of building limestone, Indiana yielding 68.9% of the product of the United States. This is the famous Bedford oolitic limestone.

SANDSTONE.

The value of sandstone in 1913 was \$7,033,067, as compared with \$6,893,511 in 1912. Although this is an increase, the production of sandstone has fallen off quite considerably in the past 12 years. The value of the sandstone production of 1904 was \$10,273,891. Thus the 1913 production shows a decrease of over 30% for the 10 years.

The largest product of the sandstone industry is building stone. The value of this product in 1913 was \$1,860,924, as compared with \$2,263,289 in 1912. Ohio, Pennsylvania and New York produced most of this stone.

ARIZONA DEPOSITS.

The stone resources of Arizona are undoubtedly quite extensive, but as yet are little developed. The major part of the stone product of Arizona up to the present time, has been used locally. The stones quarried in Arizona are granite, basalt, tuffs, and other igneous rocks, slate, marble, onyx, limestone and sandstone.

GRANITE.

Granite and related rocks occur in many areas in Arizona. In the Bradshaw mountains, at and near Prescott, in the Mule moun-

tains, near Bisbee, near Globe, and near Clifton. There is a broad band of grayish coarse grained porphyritic granite found in the Santa Rita mountains at Helvetia, in the Huachuca mountains, in the Santa Catalina mountains, near Oracle, and northward to the Superstition mountains. Granodiorite is found near Tombstone and in the Dragoon mountains. Quartz diorite is found in great masses in the Bradshaw mountains.

The granite output of Arizona is not large at present, and is confined chiefly to supplying local demands for monumental work, and for an occasional building.

DARK VOLCANIC ROCKS.

There are many large areas of basaltic lava flows in Arizona. These rocks are locally termed "malpais." This type of rock is used to some extent in Arizona for building purposes, usually on residences.

LIGHT VOLCANIC ROCKS.

These rocks are largely rhyolite tuffs, and occur quite extensively in Arizona. They are light; can be easily quarried and trimmed, and are much used for building stone. The specific gravity of this stone varies from 1.7 to 2.55, giving a weight of about 105 to 160 pounds per cubic foot. The absorption varies from about 23% in the lighter varieties to 57 in the heavier.

SLATE.

Slate occurs in Arizona in the region from the Yuma to the Bradshaw mountains; on Cave Creek, Maricopa County; near Walnut Grove, Yavapai County; and in the Rincon mountains, near Dragoon. Arizona slate has only been quarried near Phoenix, and has been used to some extent as a building stone.

MARBLE.

There are many deposits of marble in Arizona, some of them of very high grade. Near Helvetia, Pima County; in the Santa Catalina mountains, on Marble Peak; in and near the Chiricahua mountains at Bowie and Whitetail Canyon; and at Dragoon. Much marble has been shipped from the quarries near Bowie.

ONYX MARBLE.

Onyx deposits in Arizona are, in some cases, well known, but none are developed on any extensive scale. Near Mayer, on Big Bug

Creek, Yavapai County; at Cave Creek, Yavapai County; and near Greaterville, at Cave Hill, Santa Cruz County.

LIMESTONE.

There are many extensive deposits of limestone in Arizona, but so far as known, no limestone has been quarried as building stone. The major portion of limestone quarried in Arizona is used for producing lime or as a smelter flux. Some crushed stone is produced.

SANDSTONE.

Most of the sandstone produced in Arizona comes from Flagstaff. This is a fine grained reddish stone, is easily sawed and tooled, and has been exported to some extent. It is used in some California cities, as at Sacramento and Los Angeles. There is also a gray sandstone quarried near Flagstaff, which finds a local use. Other sandstone deposits are at Globe, Morenci, Bisbee, Winslow, Sunshine and Penzance.

The total production of stone in Arizona in 1913 was valued at the quarries at \$107,989, as compared with \$67,124 in 1912. As nearly as can be figured, the production of building stone was valued at \$13,495 in 1913.

The following table, taken from the United States Geological Survey for 1913, lists the rock quarries of Arizona:

GRANITE.

1. Gila Co., near Globe (in Russell Gulch).
2. Maricopa Co., Phoenix (2).
3. Yavapai Co., Prescott.
4. Yuma Co., Dome (about 2 miles east of).

DARK VOLCANIC ROCKS (BASALTS, ETC.)

1. Maricopa Co., Phoenix (12 miles north of).
2. Mohave Co., near Kingman.

LIGHT VOLCANIC ROCKS (TUFF, ANDESITE, RHYOLITE)

- | | |
|-----------------|-----------------------------|
| 1. Cochise Co. | 1. Huachuca |
| | 2. Tufa |
| 3. Coconino Co. | Flagstaff (6 miles east of) |
| Gila Co. | 4. Roosevelt |
| | 5. San Carlos |

- | | |
|-----------------|-----------------------------------|
| Maricopa Co. | 6. Phoenix (near) |
| | 7. Tempe (near) |
| 8. Mohave Co. | Kingman |
| Pima Co. | 9. Near Tucson |
| | 10. Tucson (6 miles southwest of) |
| 11. Yavapai Co. | Kirkland |

SLATE

- | | |
|-----------------|----------------------------|
| 1. Maricopa Co. | Phoenix (7 miles north of) |
|-----------------|----------------------------|

MARBLE AND ONYX

- | | |
|----------------|--|
| Cochise Co. | 1. Bowie (12 miles southeast of) |
| | 2. Dragoon (2 miles southeast of) |
| | 3. Paradise (5 miles northwest of) |
| Gila Co. | 4. Globe (10 miles west of at foot of
Sleeping Beauty mountain) |
| Pima Co. | 5. Helvetia (6 miles northeast of) |
| Santa Cruz Co. | 6. Greaterville (4½ miles south of)
(onyx) |
| Yavapai Co. | 7. Cave Creek (onyx) |
| | 8. Mayer (onyx) |
| Yuma Co. | 9. Bouse (10 miles north of) |

LIMESTONE

- | | |
|--------------|---------------------|
| Cochise Co. | 1. Lee |
| | 2. Charleston |
| Maricopa Co. | 3. Phoenix (2) near |
| Yavapai Co. | 4. Humboldt |
| | 5. Delrio (near) |

LIMESTONE AND LIME KILNS

- | | |
|--------------|------------------|
| Coconino Co. | 1. Flagstaff (2) |
| Yavapai Co. | 2. Punttenney |
| | 3. Nelson |

SANDSTONE

- | | |
|--------------|---------------------------------|
| Coconino Co. | 1. Flagstaff (1¼ miles east of) |
| | 2. Flagstaff (3 miles north of) |
| | 3. Sunshine |
| Gila Co. | 4. Globe (2) |
| Mohave Co. | 5. Haviland |
| Navajo Co. | 6. Penzance |
| | 7. Winslow |

PRICES.

Building stone is usually sold by the cubic foot or cubic yard, although sometimes the rough product is sold by the cord or ton. The prices quoted here are for the cubic foot.

Granite: Rough—about 20 cents per cu. ft.

Dressed—about \$2.50 per cu. ft.

Marble: Rough—\$1.36 per cu. ft.

Dressed—\$4.28 per cu. ft.

Limestone: Rough—22 cents per cu. ft.

Dressed—57 cents per cu. ft.

Sandstone: (No figures available)

There are many considerations affecting the production of building stone. Building stone must be durable and of a pleasing color; it must be easily worked; it must be nearly free from flaws. This last is particularly so when the stone is to be used for interior work.

Building stone is a product which has to suit the market—it is almost, if not quite, impossible to create a market for it.

Also, ordinary precautions as to transportation, labor, etc., should be looked after. The extent and quality of a deposit should be carefully ascertained before a commercial output is contemplated. The stone should be tested for color, weight, hardness, porosity and crushing strength.

FUTURE OF THE INDUSTRY

There always has been, and probably always will be, a great demand for stone for building purposes. The value of the output depends largely on local usage, as it is too bulky a product to be readily transported.

In Arizona, there is a promising outlook for the quarries. Many varieties of stone of very fine quality are found in readily accessible places, and in such a growing community, should find a ready market.

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in Arizona**



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ECONOMIC SERIES No. 11

NOVEMBER 21, 1916

INTRODUCTION

This bulletin of Arizona minerals has been compiled with the primary object of giving to the prospector and miner accurate information about the minerals of Arizona in as simple and readable form as possible. At the same time it is complete enough to serve as a useful handbook to anyone interested in the minerals of the State, and who may have a more extended knowledge of mineralogy. It is desired to make the information contained in this bulletin as accurate and complete as possible, and attention called to any inaccuracies or omissions will be appreciated.

The list of minerals given is that contained in the Directory of Arizona Minerals, Bulletin No. 3, issued by the State Bureau of Mines. In giving the localities in which a mineral occurs, no attempt has been made to name every place it has been found, but only certain well known localities have been included.

Under distinguishing features has been included the system and class in which the mineral crystallizes, as well as the more common and easily recognized features. Simple blowpipe tests have been given and rather detailed directions for the use of the blowpipe and apparatus, the object being to enable the prospector to make blowpipe tests without having to consult a textbook on the subject.

The various modes of occurrence of each mineral are given, not only as known to exist in Arizona, but in other parts of the world as well, so that the search for these minerals might be stimulated within the state. For unfamiliar terms the reader is referred to the glossary.

The section "classification of rocks" was taken, with modifications and additions, from "Practical Field Geology" by Farrel & Moses. The table given for the classification of igneous rocks is the same as used by Dr. C. H. Clapp in his geology classes of the University of Arizona. A great many other books and papers were consulted, and to all these grateful acknowledgment is made.

BLOWPIPE ANALYSIS

The advantage of blowpipe analysis lies in the fact that the tests are simple, the apparatus portable and the reagents used few in number. By means of the blowpipe an intense heat (about 1500 degrees C.) can be obtained and a variety of chemical effects can be brought about.

The apparatus used in blowpipe analysis is comparatively simple and inexpensive. The blowpipe is made in a variety of forms, the simplest being a brass tube about 10 inches long and bent at one end. The bent end or tip is perforated by a very small, smooth hole. These may be purchased cheaply in many places.

Fuel. An ordinary candle flame is excellent for blowpipe work and is convenient to carry. If possible an alcohol lamp for heating is desirable but not essential.

Charcoal. Slabs of charcoal about 4 inches long, 1 inch wide and three-fourths inch thick are used, and may be purchased in this convenient size from dealers in chemical apparatus.

Forceps. Platinum tipped forceps are best for testing the fusibility of minerals, but ordinary iron forceps filed down to small points do very well.

Hammer. A small square faced hammer is useful, but an ordinary prospecting pick with a smooth face is good.

Anvil. A small block of steel 3 inches square one one-half inch thick is convenient for powdering minerals. The flat side of a hammer or pick does very well.

Platinum Wire. A 6-inch piece of No. 27 platinum is indispensable in making bead and flame tests. The wire may be fused into a piece of glass tubing which serves as a handle.

Test Tubes. Small test tubes 4 inches long and one-half inch in diameter are necessary in making solubility tests. These may be purchased at almost any drug store for 5 cents each.

Glass Tubing. Soft glass tubing of three-eighths inch or so outside diameter are essential in making open and closed tube tests.

Magnet. A magnetized knife blade or small horseshoe magnet answers very well.

Lens. Any good magnifying glass will serve for most purposes.

DRY REAGENTS

The following reagents are used in blowpipe analysis. They may be obtained from almost any drug store at low cost:

Soda or sodium carbonate, Na_2CO_3 . Common baking soda may be used.

Borax is used for bead tests. The ordinary commercial borax may be used.

Sodium metaphosphate, NaPO_3 . This is made by fusing the salt of phosphorous and is used for bead tests.

Potassium sulphate, KHSO_4 . This is used in bismuth flux and independently.

Cupric oxide, CuO . Powdered malachite may be used instead.
Tin. Ordinary tin foil, or pieces of tin cans are used.

WET REAGENTS

The following are the more important wet reagents used in the determination of minerals. Druggists will supply these at moderate cost. Diluted acids are used in blowpipe determinations and 15 cents worth of concentrated acid will make a considerable bulk when diluted to the proper strength with water.

Hydrochloric acid, HCl . Two parts concentrated acid with three parts water (distilled water if possible) is the acid used for general purposes.

Nitric acid. HNO_3 . One part concentrated acid with two parts water.

Sulphuric acid. H_2SO_4 . One part concentrated acid with four parts water. It should be diluted with great care by pouring acid into the water rather than the reverse.

Aqua regia is a mixture of three parts concentrated hydrochloric acid and one part concentrated nitric acid. It is made up when used.

Ammonium hydroxide. NH_4 . One part concentrated NH_4OH to four parts solution.

Silver nitrate. AgNO_3 . The solid salt dissolved in water.

Barium chloride. $\text{BaCl}_2 \cdot 2\text{H}_2\text{O}$. Used in testing for sulphates.

Cobalt nitrate. $\text{Co}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$. The solid salt dissolved in water.

THE OPERATION OF BLOWPIPE ANALYSIS

I. Use of the Blowpipe.

To produce a steady flame, maintain a reservoir of air by keeping the cheeks slightly distended, and by breathing through the nose.

Oxidizing flame. (O. F.) The extreme outer tip of a *small* flame produced by a rather *strong* blast of air is most favorable for oxidation. If a candle or lamp is used the tip of the blowpipe is held just *within* the flame.

Reducing flame. (R. F.) The tip of the inner luminous cone of a *large* flame, produced by a blast of air is best for reduction. The blowpipe tip is held just outside the flame and the whole flame is directed towards the assay.

II. Flame Tests.

The color imparted to the blowpipe flame when certain minerals are heated is due to the volatilization of certain constituents, and this test is often characteristic. The colors should be viewed against a

black background such as a piece of charcoal. The chlorides are, as a rule, the most volatile compounds of the metals, so that the value of the flame test is increased by moistening the finely powdered mineral with HCl , though in some cases H_2SO_4 is better. Platinum wire is used except for compounds of arsenic, antimony, lead and copper, which may be heated on charcoal. The wire is moistened with hydrochloric acid (HCl) and touched to the powder of the mineral and heated. The wire should be cleaned after each test by dipping in hydrochloric acid (HCl) and heating, until no color is imparted to the flame, but it should never be placed directly in a reagent bottle on account of the danger of contaminating the reagent.

Red Flames.

Purplish red—lithium compounds.

Crimson—strontium compounds.

Orange red—calcium compounds.

Yellow Flames.

Intense yellow—sodium compounds.

Green Flames.

Yellowish green—barium compounds.

Yellowish green—molybdenum compounds.

Emerald green—copper compounds (without hydrochloric acid).

Bright Green (use sulphuric acid, H_2SO_4)—boron compounds.

Pale bluish green (use sulphuric acid, H_2SO_4)—phosphates.

Pale bluish green—tellurium compounds.

Pale bluish green—antimony compounds.

Bluish green—zinc compounds.

Blue Flames.

Azure blue—copper compounds with hydrochloric acid).

Pale blue—arsenic compounds.

Pale blue—lead compounds.

Violet Flames.

Pale reddish violet (viewed through blue glass)—potassium compounds.

III. Open Tube Tests.

The object of open tube tests is to heat the mineral with a good supply of air for oxidation. Glass tubes about 4 inches long and open at both ends are used, either straight or bent slightly at one end. Place finely powdered mineral near one end of the tube (at the elbow, if bent). Hold the tube steeply inclined, with the powder at the lower end, using a holder, since the whole tube will become hot. First heat the tube well just above the mineral, so as to insure a good draft, then bring the mineral over the flame.

Odor of burning matches (SO_2) sulphides and sulpho-salts.

Sublimate of minute brilliant crustals (Fe_2O_3)—arsenic and arsenic compounds.

Non-volatile amorphous sublimate (Sb_2O_3) on under side of tube—antimony compounds.

Gray metallic globules (Hg)—mercury sulphide.

IV. Closed Tube Tests.

The object of closed tube tests is to heat the mineral with little air, and hence with little oxidation. Glass tubes closed at one end are used. Two closed tubes may be made at the same time by fusing a piece of glass tubing about 5 inches long at its middle point, and pulling it apart when hot. Tubes should be clean and dry before using.

Tests.

1. Change in appearance.

Decrepitates (flies to pieces)—characteristic of many minerals.

Turns black—copper minerals.

Turns dark red—iron minerals.

Turns yellow—lead minerals.

Turns yellow (white on cooling)—zinc minerals.

2. Formation of sublimates.

Yellow sublimate (S)—some sulphides.

Black metallic mirror (As)—arsenic sulphides and sulph-arsenites.

Reddish brown (Sb_2S_3)—antimony minerals.

White volatile sublimate—ammonium salts.

Water (H_2)—hydroxides, hydrous, basic, and acid salts.

3. Formation of gases.

Colorless and odorless (CO_2)—carbonates (detected by barium hydroxide (BaOH_2)).

Colorless and odorless (O)—manganese dioxides (detected by glowing charcoal).

Brownish-red color and pungent odor (NO_2)—nitrates.

V. Treatment on charcoal.

The length of the coal should be held in line with the flame, in order to catch any sublimate that may form; it should also be tilted toward the flame. It is well to first burn a small spot on the coal with the oxidizing flame and note the color and appearance of the ash, in order to avoid confusing it with sublimate when making tests.

A slight depression is cut in the charcoal near one end and 3 or

4 grains of the mineral (not larger than pin heads) or a corresponding amount of fine powder, placed in it. In general a gentle oxidizing flame is blown first, but only for a few seconds, not allowing the blue flame to touch the mineral. Any decrepitation or deflagration (flashing like gunpowder) is noted. Odors should be sought the moment the heat is stopped, and any changes in color, formation of sublimate, metal globules, or magnetic particles, observed. The oxidizing flame is then repeated with greater intensity until reaction ceases. A similar method is followed with the reducing flame, and in many cases the reaction is facilitated by fusing the powdered mineral with three times its volume of soda, or a mixture of soda and borax, or of soda and powdered charcoal.

Tests.

1. Evolution of gas. Odor of burning matches (SO_2)—sulphides (in oxidizing flame O. F.)

Arsenic odor (As_2H_3)—arsenic compounds. (Use reducing flame R. F.)

2. Formation of sublimes. (Use oxidizing flame O. F.)

White sublimate near assay (Sb_2O_3)—antimony compounds.

White sublimate far from assay (As_2O_3)—arsenic compounds.

White sublimate, yellow when hot (ZnO)—zinc compounds.

White sublimate, yellow near assay (PbSO_4)—lead sulphide

Yellow sublimate (PbO)—lead compounds.)

Yellow sublimate (Bi_2O_3)—bismuth compounds.)

3. Reduction with soda.

Mix intimately one part of the finely powdered substance with three parts soda (Na_2CO_3) and fuse in reducing flame on charcoal—Magnetic particles—iron, nickel and cobalt compounds.

Metallic button, gray and malleable (Pb)—lead compounds.

Metallic button, malleable but brittle on edges (Bi)—bismuth compounds.

Metallic button, malleable, white (Ag)—silver compounds.

Metallic button, malleable, yellow (Au)—gold compounds.

Metallic button, malleable, red (Cu)—copper compounds.

Metallic button, malleable, white (Sn)—tin compounds.

4. Soda Fusion Test for Sulphur.

An intimate mixture of a finely powdered sulphide or sulpho-salt with about three parts soda is heated in reducing flame. The fused mass placed on a bright silver coin with several drops of water and crushed will give a black stain. (Ag_2SO).

5. Treatment with Cobalt Nitrate.

The substance is heated intensely on charcoal before and after adding a dilute solution of cobalt nitrate:

Deep blue coloration—infusible aluminum compounds and zinc silicates.

Bright green coloration—zinc compounds, except the silicates, which give a blue coloration.

Bluish green coloration—tin compounds.

Pale pink coloration—magnesium compounds (not very satisfactory test).

VI. Treatment on Charcoal With Bismuth Flux.

An intimate mixture of the substance with an equal quantity of bismuth flux (2 parts sulphur (S), 1 part potassium iodide (KI) and 1 part potassium sulphate (KHSO_4), is heated gently at one end of a charcoal tablet:

Greenish-yellow sublimate (PbI_2)—lead compounds.

Scarlet sublimate (BiI_3)—bismuth compounds.

Faint yellow sublimates (HgI_2 , etc.)—mercury, arsenic and antimony compounds.

VII. Borax Bead Tests.

A round loop ($\frac{1}{8}$ inch diameter) of platinum wire is heated in the blowpipe flame and dipped into the powdered borax. The part that adheres is fused in the flame to a clear globule; this is again dipped into the borax and the process repeated until a nearly spherical bead is obtained. The hot bead is touched lightly to a fine powder of the mineral, and is then heated thoroughly in the oxidizing flame (O. F.). The degree of solubility of the particles and the colors, if any, imparted to the bead are carefully noted. It is then heated continuously for some time in the reducing flame, and any change noted. The quantity of powdered mineral in the bead is gradually increased until a distinct reaction is obtained, or until the bead is saturated with it.

Sulphides, arsenides, antimonides, etc., must first be thoroughly roasted at dull red heat in order to convert them into oxides; otherwise no characteristic reaction will occur.

The following table gives the colors imparted to the borax bead by common metals:

	Violet	Blue	Green	Red	Brown	Yellow	Colorless
Cobalt		O. F., R. F.					
Chromium			O. F., R. F. R. F. (Opaque)				
Copper		O. F.					
Iron			R. F.				
Manganese	O. F.						R. F.
Molybdenum					R. F. O. F. (cold)		O. F. R. F. Turbid gray
Nickel	O. F. (hot)						
Tetanium	R. F.					O. F.	O. F.
Uranium			R. F.				
Vanadium			R. F.			R. F.	O. F.
Tungsten							O. F.

VIII. Sodium Meta-phosphate Bead Tests.

Beads of sodium meta-phosphate, NaPO_3 , are made just as with borax. Salt of phosphorous, $\text{HNaNH}_2\text{PO}_4$, $4\text{H}_2\text{O}$, may also be used, for on heating it loses NH_3 and H_2 , and is converted into NaPO_3 . The colors given in the table below refer to cold beads:

	Violet	Blue	Green	Red	Yellow	Colorless
Cobalt		O. F., R. F.				
Chromium			O. F., R. F.			
Copper				Red (Opaque)		
Iron		O. F.			O. F. (Pale)	O. F., R. F.
Manganese	O. F.					R. F.
Molybdenum						O. F.
Nickel			R. F.		O. F., R. F.	
Tetanium	R. F.					O. F.
Uranium			O. F., R. F.			
Vanadium			R. F.		O. F.	
Tungsten		R. F.				O. F.

IX. Reduction Color Tests.

Saturate several sodium phosphate (Na_2PO_4) beads with the substance and heat on charcoal with metallic tin in reducing flame. (R. F.). Dissolve in dilute hydrochloric acid (HCl), add tin, and then boil:

Violet solution—titanium compounds.

Deep blue solution—tungsten compounds.

Brown solution—molybdenum compounds.

Green solution—chromium, uranium and vanadium compounds.

X. Soda Bead Tests.

Beads of soda are made as with borax. Use oxidizing flame. (O. F.)

Bluish-green opaque bead (Na_2MnO_4)—manganese compounds (a very delicate test).

Yellow opaque bead (Na_2CrO_4)—chromium compounds.

Effervescence—silica.

XI. Fusibility Tests.

Long thin splinters of the mineral, about the thickness of an ordinary pencil, held with platinum tipped forceps (if at hand), or wrapped with a coil of platinum wire, are heated in the hottest part of the flame which is just beyond the tip of the inner cone of a small sharp oxidizing flame (produced by a rather strong blast). Metallic substances should be heated on charcoal as they may contain arsenic, antimony or lead, which will alloy with the platinum. Powders or substances which fly to pieces when heated may be ground into a paste with a little water, which, after careful drying, can be heated in the forceps or on charcoal. With the minerals more difficult to fuse, a smaller fragment than mentioned above, with a very thin edge or point, should be tested before deciding that it is infusible.

The following scale of fusibility shows the temperature at which minerals fuse, and gives certain minerals which fuse in each flame.

SCALE OF FUSIBILITY

(1) *Stibnite*, Sb_2S_3 . Fragments larger than standard size fuse easily in luminous flame (gas or candle; fuses easily in closed tube below red heat. (Realgar, orpiment, sulphur.)

(2) *Chalcopyrite*, CuFeS_2 . Standard size fragment fuses in luminous flame; small fragment fuses in closed tube at red heat. (Galena, arsenopyrite.)

3. *Almandite Garnet* $\text{Fe}_3\text{Al}_2(\text{SiO}_4)_3$. Standard fragment fuses readily to globule with blowpipe; only thinnest edges rounded in luminous flame. (Malachite, wernerite, stilbite.)

(4) *Actinolite*, $\text{Ca}(\text{Mg}, \text{Fe})_3(\text{SiO}_3)_4$. Edges easily rounded on standard fragment rounded with difficulty; fine splinters fuse easily to globule. (Tremolite, wollastonite, barite.)

(5) *Orthoclase*, KAlSi_3O_8 . Edges of standard fragment rounded with difficulty; only finest splinters fuse to globule. (Sphalerite, biotite, scheelite.)

(6) *Bronzite*, $(\text{Mg}, \text{Fe})\text{SiO}_3$. Only the finest points and thinnest edges can be rounded at all. (Enstatite, calamine, serpentine.)

XII. Hardness.

The resistance that a substance offers to being scratched is called hardness. It is not a property that can be exactly defined or measured, but comparative tests are expressed in terms of a so-called *scale of hardness*. The scale of hardness consists of ten minerals ranging from talc, which is very easily scratched by the finger nail, up to diamond, the hardest known substance. The minerals are numbered as follows:

1. Talc	5½. Knife blade.
2. Gypsum.	6. Orthoclase.
2½. Finger nail.	7. Quartz.
3. Calcite.	8. Topaz.
4. Fluorite.	9. Corundum.
5. Apatite.	10. Diamond.

The finger nail is about 2½, for it scratches gypsum, but is scratched by calcite. A knife blade is about 5½, for it scratches apatite, but is scratched by orthoclase. The hardness of a mineral is judged both by its effect on the minerals of the scale and their effect upon it. If a mineral scratches fluorite, but is scratched by apatite, it has a hardness of 4½. Two minerals of the same hardness will scratch each other.

Much care should be used in determining the hardness. Sometimes too high a value will be obtained, because a foreign substance is embedded in the mineral. A soft mineral leaves a mark on a harder one, so the mark left by a mineral should be a distinct groove. Minerals made up of grains or fibres should be tested with care, for a scratch may seem to exist when really it is due to the forcing apart of the grains. A sandstone made up of quartz grains with a

hardness of 7 may appear to have a hardness of about 3, because the grains are rather loosely cemented.

For the convenience of the user of this bulletin a list of the elements and the symbols commonly used is here inserted. Many of the elements and their compounds are comparatively rare and some of them are omitted from this list.

Symbol	Element	Symbol	Element
Al	Aluminum	Li	Lithium
Sb	Antimony	Mg	Magnesium
A	Argon	Mn	Manganese
As	Arsenic	Hg	Mercury
Ba	Barium	Mo	Molybdenum
Be	Beryllium	Ni	Nickel
Bi	Bismuth	N	Nitrogen
B	Boron	O	Oxygen
Br	Bromine	P	Phosphorus
Cd	Cadmium	Pt	Platinum
Ca	Calcium	K	Potassium
C	Carbon	R	Radium
Cl	Chlorine	Si	Silicon
Cr	Chromium	Ag	Silver
Co	Cobalt	Na	Sodium
Cu	Copper	Sr	Strontium
F	Fluorine	S	Sulphur
Au	Gold	Te	Tellurium
He	Helium	Sn	Tin
H	Hydrogen	W	Tungsten
I	Iodine	U	Uranium
Ir	Iridium	V	Vanadium
Fe	Iron	Zn	Zinc
Pb	Lead		

ROCK CLASSIFICATION

As an aid to the prospector and field geologist, a brief description of the common method of classifying rocks is given here. A more complete classification would, of course, require a more detailed knowledge of rocks than is here given and more elaborate tests.

A rock has been defined as "any mineral or aggregate of minerals that forms an essential part of the earth's crust." According to this definition a rock may be made up of a single mineral or many different ones, but it must be quite an extensive formation, distinguishing it

from the ore deposits, which do not, as a rule, occur on a large scale.

Rocks generally are divided into three classes:

1. Igneous.
2. Metamorphic.
3. Sedimentary.

An igneous rock is one formed by the solidification of a molten mass, either upon the surface of the earth or in its depths. The igneous rocks are characterized in general by their massive structure, that is, they do not show true bedding or stratification, although in volcanic flows the successive layers may closely resemble bedding. All except the very fine textured igneous rocks may be recognized by their crystalline composition; crystals show characteristic cleavages, and straight-edged outlines. Or if the rock cooled very slowly, the crystals will not have developed straight-edged outlines, but will have grown together along irregular boundaries. The rock mass, however, is evidently made up of different kinds of materials.

There are no definite lines of demarcation between the different types of igneous rocks; one geologist may give a rock one name, while another may place the same rock in a different group. This is because these rocks form a series in which one type merges gradually into the next, and the transition specimens may be put into either class. For example, a rock containing orthoclase, and plagioclase feldspar, quartz, biotite and hornblende might be classed either as a granite or a quartz diorite. The distinction between the two is that in a granite, orthoclase is the predominant feldspar, while in quartz diorite, there is more plagioclase.

The reason why igneous rocks form a graded series is that they result from the cooling of molten masses which are really solutions of the rock forming elements. When such a solution, called a "magma," solidifies, the conditions of temperature and pressure determine the progress and nature of the crystallization of the mineral forming elements; and since these conditions are subject to variations, the resulting rocks show corresponding differences. The chemical composition of the different magmas may show gradations which determine the type of the resulting rocks. The field classification is based upon rock texture and mineralogical composition.

Rock Textures.

It is evident that if a molten mass is chilled very quickly the processes of crystallization will be entirely arrested or confined to merely the initial stages. Such conditions would cause the formation of glasses. These may have been poured out upon the surface, or may

have been brought suddenly into contact with cold rocks underground.

If crystallization had just started and a few crystals developed in a non-crystalline, or very finely crystalline matrix or ground mass, the texture of the rhyolites, dacites, basalts, etc., results. The texture is said to be "felsitic" when the rock is made up of crystals too small to be seen with the unaided eye.

If the matrix or ground mass forms a greater part of the rock than the phenocrysts (crystals with complete crystal outlines) the texture is porphyritic and the rocks are called rhyolite (or andesite or basalt, etc.) porphyries. With the phenocrysts forming a greater proportion of the rock than the ground mass, the texture is also porphyritic, but the name of the next succeeding group is prefixed, giving the granite porphyries, gabbro porphyries, etc.

The granitic texture results when the rock mass has cooled very slowly, so that all the constituents crystallize before any particular ones have finished their growth, giving an equigranular rock of phenocrysts. In this division belong the granites, diorites, gabbros, etc.

The table which is given below for the easy classification of igneous rocks divides rocks according to the predominating minerals in them, and also according to the character and number of the phenocrysts. To help in the use of the table some of the common minerals found in rocks are described here and certain terms defined.

The principal rock forming minerals are:

Quartz	Hornblende
Orthoclase feldspar	Pyroxene
Plagioclase feldspar	Olivene
Biotite	

Quartz cannot be scratched with a knife and has a glassy appearance on fresh surfaces. It occurs in rocks in hexagonal crystals or as rounded grains, and also as a cementing material or ground mass between other crystals.

Orthoclase feldspar may be scratched by quartz. When fresh it is scratched only with difficulty by a knife blade; as it alters or weathers it becomes clayey and is easily scratched. It is distinguished by its cleavage; it breaks in a blocky manner with the shining cleavage faces at right angles and showing no grooves (striae). The color is white, pale yellow, or pink in mass.

Plagioclase feldspar is distinguished from orthoclase by flashing the shining cleavage faces so that they reflect the light, when they will show grooving or striations, which look like parallel scratches.

The surface may also show a play of iridescent colors. The color is usually gray in mass.

Biotite is readily scratched by a knife blade. It characteristically occurs in flakes or scales which may show a six-sided outline. The crystals can usually be separated into thin sheets which are elastic. The color is black or brown in mass.

Hornblende is scratched with difficulty by a knife blade. The crystals are characteristically long and narrow (prismatic). The color is dull dark green to black in mass.

Pyroxene is scratched by a knife blade. The crystals are usually short. It is distinguished from hornblende by its different cleavage angles (90°) and the shorter crystal form. The color is pale green to nearly black.

Olivine is scarcely scratched with a knife. It usually occurs in translucent grains; it is insoluble. The color is characteristically green, also yellow. The grains often resemble fragments of broken bottle glass.

The following terms used in the table for igneous rocks are here defined:

Phaneric rocks are those which have cooled slowly and which are composed entirely of crystalline materials which are easily visible.

Porphyritic rocks are those with crystals set in a fine ground mass.

Phaneric-porphyritic—rocks composed of phaneric crystals with one kind larger than the other.

Aphanitic—Not composed of visible crystals or grains. Phenocrysts may be set in an aphanitic ground mass.

Aphanitic-porphyritic—composed of crystals or grains set in an aphanitic ground mass.

TABLE FOR CLASSIFICATION OF IGNEOUS ROCKS

Essential Minerals	Quartz and Feldspar	Feldspar	Feldspar Dark Minerals	Dark Minerals Feldspar	Dark Minerals Only
Phaneric- Equi- granular	Granite	Syenite	Diorite	Gabbro	Peridotite
Phaneric- Porphyritic	Granite ¶	Syenite ¶	Diorite ¶	Gabbro ¶	Peridotite ¶
Aphanitic- Porphyritic	Rhyolite ¶ or ¶ rhyolite	Trachyte ¶ or ¶ trachite	Andesite ¶ or ¶ andesite	Basalt ¶ or ¶ basalt	Basalt ¶ or ¶ basalt
Aphanitic	Rhyolite	Trachyte	Andesite	Basalt	Basalt
Families	Granite	Syenite	Diorite	Gabbro	Peridotite

¶ This sign is used to indicate porphyry.

CLASTIC ROCKS

A clastic rock is one composed of fragments of some earlier formation. The clastic rocks may be separated into four classes:

1. Material laid down from mechanical suspension in water.
2. Material ejected by volcanoes, possibly deposited with a good deal of water.
3. Material transported by the wind.
4. Material deposited from solution.

The rocks of the first class are commonly called "sedimentary rocks" since they are laid down as sediments from water in river beds, lake and sea bottoms. The distinguishing feature of sedimentary rocks is bedding, or stratification; this results from the laying down of successive layers of material of different character, which may be seen on any beach at the present time. Close to the shore are larger stones and pebbles, further out sand is deposited; a slight subsidence of the shore line would result in sand being laid over the pebbles; if the sinking continued, mud would cover the sand, and the next stage, if it were an ocean bottom, would be the deposition of shells and skeletons of marine animals. Due to the pressure of overlying beds, such a series would appear as conglomerate, sandstone, shale and limestone.

In general, rounded polished surfaces are typical of the sedimentary fragments; the material is usually sorted or classified since coarse material is not transported so readily as fine sand or silt. Other traces of water action, such as ripple marks, may also be seen.

Glacial material is usually unsorted (but may show water polishing) and the different fragments may be quite different in origin.

Volcanic material may consist of coarse and fine fragments together, or may be classified to some extent as a result of heavy rains accompanying the eruption. The resulting tuffs and breccias are sometimes very hard to identify, especially when they have been subjected to alteration or metamorphism.

Exact classification of the sedimentary rocks may be made on the basis of the size and shape of the component fragments, but for the field work it will be sufficient to place the rock in the following tabulation:

A. Breccia—angular fragments cemented.

1. Fault breccia, formed of the fragments crushed in fault movement.
2. Talus breccia—resulting from the accumulation of broken fragments upon a slope.
3. Volcanic breccia—fragments ejected by a volcano or caught up in an igneous mass.

B. Mechanical sediments.

1. Conglomerate, a rock consisting of cemented fragments of varying sizes, showing water action, or wind polishing.
2. Arkose, a sedimentary rock consisting of feldspar, quartz, and possibly, mica.
3. Sandstone, composed of quartz chiefly, rounded grains, relatively small and water sorted to finer sizes.
4. Shale, composed of the finer material, usually clayey, deposited after the fine sandstones.
5. Clay and marl, the last products of the sorting and water deposition processes.

C. Organic sediments.

1. Limestones, made up of calcareous shells, and skeletons of marine animals.
2. Infusorial earth, composed of the minute siliceous shells of microscopic marine animals.
3. Siliceous sinters, or hot spring deposits.

D. Other organic remains, and chemical precipitates.

In this group come the iron ores, coal, gypsum, salt, etc.

THE METAMORPHIC ROCKS

This group perhaps forms a larger part of the earth's crust than the other two combined, since it is comparatively rare for a rock formation not to be changed to some extent. But since the metamorphic rocks are other types altered, it is hardly necessary to attempt a complete separate classification.

The agents of metamorphism are (1) dynamic action—folding and shearing of the rock formations, and (2) chemical action.

When a coarse textured rock has been compressed, folded and sheared, the crystals or fragments are elongated and the rock has a striped or banded appearance, which may in some cases resemble bedding; such a rock is called a "gneiss" and may result from metamorphism of some coarser igneous types. Thus there are granite, gabbro, or diorite gneisses. A conglomerate gneiss results from the shearing of a coarser sedimentary rock.

If the leaves or laminae are thinner so that the rock splits readily along more or less parallel planes, it is called a "schist." The rhyolite and andesite schists are derived from the corresponding igneous types. The schist are often classified according to the ferro-magnesian mineral present—so that there are mica schists, hornblende schists, etc. Their origin is often obscure and hard to determine.

Quartzites are formed by the metamorphism of sandstones; sometimes no trace of the original grains and bedding planes can be found in the field, in which case the rock may be confused with quartz of igneous origin.

Slates result from the metamorphism of the finer sediments under dynamic action. They are distinguished by blocky fracture or sheeted structure, due to the development of a cleavage at an angle with the bedding planes.

Limestones, when closely folded, show varying degrees of crystallization, ranging from large rhombic crystals of calcite to fine sparkling "frosty" surfaces. The traces of fossils become very obscure, and even bedding planes may be obliterated. Impure limestones when metamorphosed form "ophicalcites," in which masses of serpentine are surrounded by calcite and dolomite.

Talcs and serpentines may result from the metamorphism of impure limestones, but are chiefly due to the alteration of basic igneous rocks.

Under the influence of chemical action, various changes take place in the original rock types. The igneous rocks may be largely silicified and their original character lost. Limestones develop aggregates of

garnet and other metamorphic minerals. Replacement of limestone by silica gives a rock which may be taken for quartzite; the texture is usually fine and traces of the original bedding may be found. Such silicified limestones are frequently called "quartzite," "flint" or "hornstone."

A variety of problems confront the field observer, some of which can be solved only by a microscopic study of a thin section of the rock and this is the work of a trained petrographer.

TABLE FOR THE EXAMINATION OF ROCKS

A. Igneous Rocks.

1. Texture, historical deductions.
2. Mineralogical composition.
 - a. Essential minerals.
 - b. Accessory minerals.
3. Relative Age of the Minerals.
 - a. Minerals formed with crystal boundaries are older than the surrounding ones, without crystal boundaries.
 - b. Included minerals are older than those which include them.
 - c. Minerals abutting without crystal boundaries are of the same age, approximately.
 - d. Intergrown minerals are of the same age.
 - e. Minerals cutting others are younger than the ones they cut.
4. Alteration and Metamorphism.
 - a. Degree of change, extent to which original minerals are changed.
 - b. Character of the change, secondary minerals due to alteration, metamorphic minerals.

B. Sedimentary Rocks.

1. Relative sizes and shapes of the component minerals.
 - a. Unsorted material, large and small fragments together imply that the source of the material is near at hand or that the transporting agent is very powerful.
 - b. Angular grains, fresh in appearance indicate disintegration without decomposition, and little movement from source.
 - c. Rounded grains, fresh, imply disintegration and transportation of material.
 - d. Sorted material, where the grains are similar in mineralogical character, indicate that the deposits were

made some distance from the source, or the original rock disintegrated and weathered also, differentiating the more resisting minerals.

2. Look for fragments which give some clue as to the source from which the sedimentary material is derived.
 3. Determine the character and probable origin of secondary or cementing material.
- C. With metamorphic rocks try to determine:
1. The nature of the original constituents and the original rock. Look for traces of original minerals in forms of cleavage.
 2. The nature of the alteration.
 - a. Dynamic—folding, shearing, etc., distortion of crystals or fragments.
 - b. Chemical change, older minerals partially dissolved by later ones.
 3. The history or sequence of the changes.

MINERALS

(FOR UNFAMILIAR TERMS SEE GLOSSARY AT END)

ALABASTER. (Anhydrous gypsum) CaSO_4 .*Locality*:—Occurs in Superstition mountain; near Pueblo Viego; near Sulphur Springs; in La Gila Range, and elsewhere.*Distinguishing Features*:—See Gypsum.*Occurrence*:—See Gypsum.**ANDRADITE.** (Calcium-Iron-Garnet. Black Garnet. Common Garnet.) $\text{Ca}_3\text{Fe}_2(\text{SiO}_4)_3$.*Locality*:—See Garnet.*Distinguishing Features*:—May contain manganese, ferrous and ferric iron, titanium, or yttrium. Color may be brownish red, brown, grayish black, black, various shades of yellow or green. Hardness, 7. Sp. Gr. varies from 3.5 to 4.2. Fusibility 3 to 4. Insoluble before fusion but after fusion gelatinizes with hydrochloric acid. (HCl).*Occurrence*:—In crystalline limestones, especially at contacts, associated with wollastonite, diopside, vesuvianite, etc. In nepheline and leucite bearing lava, such as phonolites.*Uses*:—Used as an abrasive, especially for finishing wood and leather. Transparent varieties are used for gems.**ANGLESITE.** PbSO_4 .*Locality*:—Tombstone district, Cochise County; Gila County at Lost Gulch mine, near Globe; Mohave County, in Mineral Park; Pima County, in Mammoth mine; Yavapai County, in ores of Bradshaw mountains; Yuma County, in Castle Dome district; common in silver veins.*Distinguishing Features*:—Brittle. Hardness 3. Sp. Gr. 6.1 to 6.4. Adamantine lustre, sometimes resinous or greasy. Transparent to opaque. Colorless, white, yellow, brown, green, or blue. White streak.*Blowpipe Tests*:—Fuses easily in candle flame. Reacts for lead and sulphur. Slightly soluble in nitric acid. Powdered anglesite soluble in warm concentrated sulphuric acid. Soluble in $\text{NH}_4\text{C}_2\text{H}_3\text{O}_2$ (made by neutralizing acetic acid with ammonia).*Occurrence*:—Anglesite is a common oxidation product of lead minerals, especially galena. Hence it is found in cracks and cavities in galena. Also occurs in masses with a banded structure.*Uses*:—Anglesite is an ore of lead.

ANTIMONY ORES. (See Jamesonite and Stibnite.)

ARGENTITE. (Silver Glance.) Ag_2S .

Locality:—Mohave County, in pre-Cambian granite gneiss in Chloride, Mineral Park, and Stockton Hill districts; Pinal County, at Silver King; Santa Cruz County, at Montezuma and Empress of India mines, Tyndall district; Yavapai County, in ores of Bradshaw mountains.

Distinguishing Features:—The crystals are isometric, the only common form being the cube. Crystals are often arranged in parallel position. Conchoidal fracture, not very distinct; malleable, sectile; takes impression. Hardness, 2 to 2.5. Sp. Gr., 7.2 to 7.4. Color is dark lead gray, almost black. Fresh surfaces show high metallic lustre, but on exposure soon becomes dull and black. Shiny streak.

Blowpipe Tests:—Easily fusible. ($1\frac{1}{2}$) On charcoal yields a malleable button of silver. Soluble in nitric acid, with separation of sulphur. Hydrochloric acid gives white precipitate, (AgCl) soluble in ammonium hydroxide. (NH_4OH .)

Occurrence:—As a vein mineral associated with other silver minerals; also associated with cobalt and nickel minerals.

Uses:—Argentite is an important ore of silver.

ARSENOPYRITE. (Mispickel, Arsenical Pyrite.) FeAsS .

Locality:—Mohave county, in pre-Cambian granite gneiss, in Chloride and Mineral Park districts; Minnesota-Connor, Windy Point, and Queen Bee mines; (carries gold and silver; not mined for arsenic). Yavapai County, in veins of Bradshaw mountains; carries gold and some silver at McCabe mine.

Distinguishing Features:—Arsenopyrite is found in well-formed crystals, as well as in disseminated grains and compact masses. Distinct prismatic cleavage. Uneven fracture. Brittle. Hardness, 5.5 to 6. Sp. Gr., 5.9 to 6.2. Color is tin-white to a light steel gray, tarnishing to brass yellow or gray. Streak is black. Opaque; metallic lustre.

Blowpipe Tests:—Fusibility 2. On charcoal gives garlic odor and a black magnetic globule. In the closed tube on further heating an arsenic mirror is formed. Soluble in nitric acid with the separation of sulphur.

Occurrence:—As a vein mineral. Commonly associated with the ores of tin, nickel, cobalt, silver, gold and lead; also with pyrite, chalcopyrite, and sphalerite.

Uses:—Arsenopyrite is the chief source of the white arsenic (As_2O_3) of commerce.

ASBESTOS. (Chrysotile.) $\text{H}_4\text{Mg}_3\text{Si}_2\text{O}^9$.

Locality:—Coconino County, associated with serpentine in limestone at Grand View and Bass camps, Grand Canyon; Gila County, fine specimen found on Ash Creek, 35 miles northeast of Globe, and in massive serpentine 20 miles west of Globe.

Distinguishing Features:—Chrysotile is one of the two distinct modifications of serpentine, and is more common than the other, antigorite. Chrysotile is characterized by its fibrous structure. It occurs in several varieties: (1) common serpentine; (2) precious serpentine; (3) verd-antique, or ophicalite; and 4() fibrous serpentine, or asbestos. The latter consists of delicate, fine, parallel fibres, which can be easily separated. Fibres are flexible and adapted for spinning. Silky to silky metallic lustre. Various shades of green in color, also yellowish and brownish. Usually found in narrow veins. The fibres extend across the veins. Sometimes called short-fibred asbestos.

Uses:—Asbestos is used extensively in the manufacture of non-conductors of heat and incombustible materials, such as cloth, board, felt, rope, paper, paint, cement, and theatre curtains.

AZURITE. (Hydrous Carbonate of Copper.) $\text{Cu}_2(\text{OH})_2(\text{CO}_3)_2$.

Locality:—Cochise County, was abundant at the Copper Queen mine, Bisbee district. The finest specimens of azurite in many museums have come from this mine. Gila and Pinal Counties; rare in Globe district. Greenlee County, large masses in Longfellow, Manganes Blue, and Shannon mines. Yavapai County, in ores of Bradshaw mountains.

Distinguishing Features:—Usually compact, in reniform and botryoidal masses, often with a velvety, radial fibrous structure; also earthy and in crusts. Uneven fracture; brittle. Hardness, 3.5 to 4. Sp. Gr. 3.7 to 3.8. Vitreous to adamantine lustre. Light azure to deep blue in color. Translucent to opaque.

Blowpipe Tests:—Streak, light blue. Easily fusible at 3, giving a green flame which is made blue by HCl . In closed tube it turns black and gives off H_2O . Soluble in acids with effervescence.

Occurrence:—As secondary mineral in the upper oxidized zone of copper deposits. It is usually associated with malachite and has been formed after the malachite.

Uses:—Azurite is one of the so-called oxidized copper ores. Sometimes used for pigment in paint, but is not very durable. (Color changes to green.)

AZURMALACHITE. (Carbonate of Copper.)

Locality:—Cochise County, blue azurite and green malachite, an ornamental stone found in the copper mines of the Bisbee district. Mohave County, an impregnation of porphyry at John Kay mine, Mineral Park.

Occurrence and Blowpipe Tests:—Same as for azurite.

BISMUTH.

Locality:—Native bismuth not known to occur in Arizona. The telluride of bismuth is found in Yavapai County in the Montgomery mine, at Minnehaha, and near Bradshaw City.

Distinguishing Features:—Crystals of native bismuth are rare. It is reticulated, arborescent, in plates; also foliated and compact masses. Perfect basal cleavage. Brittle, easily pulverized with the hammer. Sectile, somewhat malleable when heated. Hardness, 2.5. Sp. Gr., 9.8. Metallic lustre. Reddish silver-white in color, often shows brassy yellow tarnish color.

Blowpipe Tests:—Easily fusible at (1) to a malleable globule, which is brittle on the edges. With bismuth flux on charcoal gives a bright red sublimate. Soluble in nitric acid. The solution diluted with water gives a white precipitate. ((BiO) No₃.)

Occurrence:—As a vein mineral, usually associated with cobalt and silver minerals.

Uses:—Native bismuth is the chief source of the bismuth of commerce, which is used principally in alloys.

BORNITE. (Peacock Ore.) Cu₅FeS₄.

Locality:—Cochise County, small quantities in quartz veins in Whetstone mountains. Mohave County, at Altata and Pinkham mines, Chloride district; Santa Cruz County, small quantity at Line Boy prospect, near Duquesne; Yavapai County, common in copper veins.

Distinguishing Features:—Bornite occurs in masses, very rarely in rough cubic crystals. Conchoidal to uneven fracture. Hardness, 3. Sp. Gr., 5.1. Metallic lustre. Color on fresh surface is a brownish-red bronze, with purple tarnish.

Blowpipe Tests:—Fusible at 2½ on charcoal reducing flame to a magnetic globule. Streak, gray black. In closed tube gives a faint sublimate of sulphur. Soluble in nitric acid with the separation of sulphur. Also concentrated hydrochloric acid.

Occurrence:—(1) As a vein mineral associated with chalcocite and chalcopyrite. (2) As a contact mineral between limestones and igneous rocks. (3) As a product of secondary enrichment.

Uses:—Bornite is an important ore of copper.

BROCHANTITE. (Oxide of Copper.) $\text{CuSO}_4 \cdot 3\text{Cu}(\text{OH})_2$.

Locality:—Cochise County, small quantities often associated with cuprite in Copper Queen and Calumet & Arizona mines; Greenlee County, common with malachite in Clifton-Morenci district; mined at Shannon, Metcalf, Copper Mountain, and Montezuma mines; Yavapai County, United Verde mine, Jerome.

Distinguishing Features:—Brochantite is found in small, short prismatic crystals with vertical striations. Also reinform with fibrous structure and as drusy crusts. Perfect cleavage. Hardness, 3.5 to 4. Sp. Gr., 3.9. Emerald to blackish green in color. Vitreous to pearly lustre. Transparent to translucent.

Blowpipe Tests:—Streak, light green; fusible at 3.5. In closed tube turns black and gives off water. Insoluble in water. Soluble in nitric acid, *without* effervescence (distinction from malachite, which it greatly resembles). Fuses on charcoal and yields a globule of metallic copper. Reacts for sulphur with soda on charcoal.

Occurrence:—A secondary mineral associated with other copper minerals—malachite, azurite and cuprite.

BROWN IRON ORE. (See Limonite.)

CARNOTITE. (Ore of Uranium.)

Locality:—Navajo Reservation.

Carnotite is an impure uranyl vanadate. It contains a high percentage of uranium, and is a possible source of radium.

CEMENT MATERIAL.

Locality:—Occurs in many places, as at Flagstaff and near Phoenix. Was utilized at Roosevelt Dam. Portland cement is made from limestone containing varying amounts of magnesia, silica, and alumina. After ignition this will set under water.

CELESTITE. (Stronium Sulphate.) SrSO_4 .

Locality:—Maricopa County, occurs at Gila Bend.

Distinguishing Features:—Occurs also in fibrous and cleavable masses; more rarely granular, globular, or earthy. Perfect basal and good prismatic cleavages. Uneven fracture. Hardness, 3 to 3.5. Sp. Gr., 3.9. Vitreous to pearly lustre, on fracture surfaces somewhat greasy. Color is white, pale blue, sometimes red, and colorless.

Blowpipe Tests:—Fusible at (b) giving a crimson red flame

especially with hydrochloric acid. The water solution of the soda fusion gives a white precipitate with BaCl_2 (barium chloride) which is insoluble in HCl . Insoluble in acids.

Occurrence:—(1) Disseminated in shales, limestones, and dolomites. Dissemination may be in the form of well developed crystals or as irregular particles of varying sizes. (2) In cracks and cavities of rocks of varying ages but principally of sedimentary origin. Here celestite is a secondary formation, having been derived from the overlying and adjoining celestite-bearing rocks by the action of circulating water.

Uses:—Celestite is used to small extent in the manufacture of strontium compounds.

CERARGYRITE. (Horn Silver.) AgCl .

Location:—Mohave County, in the pre-Cambrian granite gneiss, in Chloride, Cerbat, and Stockton Hill districts; mined at Distaff mine, Chloride district; Gila County, Black Warrior district; Yavapai County, Bradshaw mountain district; common in silver mine; Santa Cruz County, Tyndall district; Cochise County, Commonwealth mine, Pearce.

Distinguishing Features:—Crystals are rare and poorly developed. Usually massive and disseminated, as a crust or coating; stalactitic, dendritic. No cleavage; conchoidal fracture. Highly sectile; waxy. Hardness, 1.5. Sp. Gr., 5.5. Pearly gray, yellowish, greenish, or white in color; on exposure to light turns violet, brown or black. Resinous adamantine lustre. Transparent to translucent. When rubbed becomes shiny.

Blowpipe Tests:—On charcoal fuses easily at 1, giving a silver button. A fragment touched with NaPO_3 (sodium phosphate) bead saturated with CuO (copper oxide) gives an intense azure blue flame. Insoluble in acids. Slowly soluble in NH_4OH (ammonia).

Occurrence:—A secondary mineral in the upper part of silver deposits. It is formed by the action of chloride-bearing waters on other silver minerals, and therefore is prominent in arid regions.

Uses:—Important ore of silver.

CERUSSITE. Lead Carbonate) PbCO_3 . (White Lead Ore.)

Locality:—Cochise County, Bisbee district; Gila County, Red Cloud mine; Greenlee county, mined for gold values at Horneyer mine, Morenci; Mohave County, in Mineral Park district, Tyler mine; Pima County, in Greaterville placer deposits; (silver and gold values); Pinal County, Haley claim, $2\frac{1}{2}$ miles east of Ray; Santa Cruz County, Morning and Flux mines.

Distinguishing Features:—Crystals often arranged in clusters or star-shaped groups. Also compact, in granular and, more rarely, fibrous masses; reniform, stalactitic, in crusts, and earthy. Distinct prismatic cleavage, conchoidal fracture. Brittle. Hardness, 3 to 3.5. Sp. Gr., 6.5. Colorless, white, gray, yellow, brown, blue, green and black. Greasy or resinous lustre. Transparent to translucent.

Blowpipe Tests:—Streak white. Fuses easily. In closed tube decrepitates and becomes yellow. Heated on charcoal in reducing flame, it gives a metallic button and a yellow coating. Soluble in HNO_3 (nitric acid) with effervescence. Soluble in HCl (hydrochloric acid), but on cooling, needle crystals of adamantine lustre, PbCl_2 (lead chloride) separate out.

Occurrence:—As a secondary mineral derived from galena. It occurs especially in the gossan of ore deposits.

Uses:—Cerussite is an ore of lead and sometimes argentiferous.

CHALCANTHITE. (Blue Vitrol or Blue Stone.) $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$.

Locality:—Greenlee County, small quantities mined at Copper Mountain, Clifton-Morenci district; Yavapai County, considerable quantity formerly in United Verde mine, Jerome district.

Distinguishing Features:—Generally occurs in crusts with reniform, stalactitic or fibrous structure. Imperfect cleavage. Conchoidal fracture. Hardness, 2.5. Sp. Gr., 2... Brittle. Vitreous lustre. Color varies from deep to sky or greenish blue. Translucent. Disagreeable metallic taste.

Blowpipe Tests:—Fusibility, 3. Green flame. Reducible to metallic copper with soda on charcoal. Readily soluble in water yielding a blue solution. The water solution placed on metallic iron (knife blade) gives a film of copper. In a closed tube turns white, then black, yielding abundant water.

Occurrence:—A secondary mineral often found in abandoned mine drifts.

Uses:—Rarely occurs in sufficient quantities to be of commercial importance. Artificial compound used extensively in copper plating, in batteries, as a mordant, preservative of timber, for spraying plants, etc.

CHALCEDONY. SiO_2 .

Locality:—Greenlee County, in limestone in Clifton-Morenci district; also loose on Shannon mountain; Mohave County, gray, purplish, and white on western slope of River Range and other localities; Santa Cruz County, Grosvenor Hills. (See Chrysoprase.)

Distinguishing Features:—A transparent to translucent variety of

quartz, having a wavy lustre. May be stalactitic, botryoidal, concretionary, and often lines cavities. Is white, grayish, pale to dark brown, blue, or black. Fracture more or less conchoidal. No cleavage. Hardness, 7. Sp. Gr., 2.6.

Blowpipe Tests.—Same as for quartz. Chalcedony is more soluble in KOH (potassium hydroxide) than quartz.

Occurrence.—(1) As a secondary mineral in seams and cavities of various rocks, especially the volcanic igneous rocks. (2) As chert, or flint, and jasper, which occur in concretions, lenses, or layers in sedimentary rocks.

Uses.—Agate, chrysoprase (apple green translucent chalcedony) and jasper are used as ornamental stones.

CHALCOCITE. (Copper Glance.) Cu_2S .

Locality.—Common below oxidized zone in most copper mines of the state. Cochise County, formerly most important sulphide near Bisbee; in Copper Queen, Calumet & Arizona, and other mines, but chalcopryite has succeeded it at greater depth. Abundant in massive form in Shattuck mine, Bisbee. Gila and Pinal counties, the essential constituent of the disseminated ores in schist and porphyry at Ray and Miami; in Old Dominion mine, near Globe; with bornite forms rich ore of Queen mine at Superior; Greenlee County, principal copper mineral in Clifton district; in Ryerson and other mines; Mohave County, Chloride district; Pima County, occurs in Cobriza mine, Cababi district; Yavapai County, in copper-silver veins of Bradshaw mountains; Yuma County, in prospects at Cinnebar, 8 miles southwest of Quartzite.

Distinguishing Features.—Crystals are usually thick tabular or short prismatic. Usually compact and disseminated mass; granular. Indistinct prismatic cleavage. Conchoidal to uneven fracture. Hardness, 2.5. Sp. Gr., 5.7. Metallic lustre on fresh surface, which soon becomes dull to black. Color, dark lead gray, often tarnished blue or greenish; streak, shiny lead gray.

Blowpipe Tests.—Fusibility (2). Unaltered in closed tube. In reducing flame on charcoal gives metallic copper. Soluble in HNO_3 (nitric acid), giving brown-red fumes, residue of sulphur, and a green solution.

Occurrence.—(1) As a vein mineral. (2) As a product of secondary enrichment. (3) As a replacement of lignite.

Uses.—Chalcocite is a valuable ore of copper on account of its high percentage of copper.

CHALCOPYRITE. (Copper Pyrites.) CuFeS_2 .

Locality:—Found in nearly all the copper mines of the State. Cochise County, in massive form in Bisbee district; Gila and Pinal counties, abundant with specularite in Gibson mine as vein in schist, Globe district; with pyrite in veinlets and in disseminated form in so-called "primary ore" of mines at Miami and Ray. Greenlee County, small proportion in copper ore bodies in Clifton-Morenci district. Mohave County, primary ore of Chloride district, in Pay Roll and Redemption mines; primary ore, Mineral Park district, in Keystone, Windy Point and other mines; Cerbat district, in Cerbat and Alpha mines; Stockton Hill district, in Banner Group and Treasure Hill mines; Helvetia and Silver Bell districts. Pima County, important copper ore at Old Boot, Leader and Ridley mines; occurs also in quartz veins at McCleary prospects, 10 miles southwest of Helvetia. Santa Cruz County, in Tyndall district at American Boy mine. Yavapai County, in ores of Bradshaw mountains and United Verde mine, Jerome district.

Distinguishing Features:—Chalcopyrite occurs in crystals, in masses, and disseminated through the rock. Faces of large crystals are often dull, striated, and furrowed. Conchoidal to uneven fracture. Hardness, 3.5 to 4. Sp. Gr., 4.2. Brittle. Brass to gold yellow in color. Tarnishes to various blue, purple and black tints. Iridescent.

Blowpipe Tests:—Greenish-black streak. On charcoal fusible at 2, to a magnetic globule, which, heated with soda, gives a copper button. In closed tube decrepitates and gives a sublimate of sulphur. Soluble in HNO_3 (nitric acid) to a green solution with separation of sulphur.

Occurrence:—(1) As a vein mineral associated with pyrite, galena, sphalerite, etc. (2) In basic igneous rocks. (3) Disseminated through massive pyrite. (4) In folds of schist and gneiss. (5) As a contact mineral with magnetite or hematite.

Uses:—Chalcopyrite is the principal ore of copper.

CHRYSOCOLLA. (Silicate of Copper.) $\text{CuSiO}_3 \cdot 2\text{H}_2\text{O}$.

Locality:—Cochise County, Bisbee district, Calumet & Arizona mine, 3 miles north of Dragoon; not abundant. Coconino County, in sandstone of White Mesa of Navajo Indian Reservation. Gila and Pinal Counties, formerly a more important ore than at present; in Globe district abundant at Live Oak, Keystone, Black Warrior, Geneva and Black Copper mines. Graham County, common, but not important in Clifton-Morenci district. Yavapai County, in Bradshaw Mountain district, common in outcrops of copper veins.

Distinguishing Features:—Apparently amorphous. Never found in crystals. Occurs in earthy masses, in crustations and seams. Sometimes reniform, botryoidal, and stalactitic. Conchoidal fracture. Hardness, 2 to 4. Sp. Gr., 2 to 2.2. Shiny, vitreous, greasy lustre. Various shades of green and blue; when impure, brown to black.

Blowpipe Tests:—Pure varieties have a greenish white streak. Infusible. Colors the flame green. In the closed tube it blackens and gives water. Decomposed by hydrochloric acid (HCl) without gelatinization.

Occurrence:—A secondary mineral, often associated with malachite, azurite, and cuprite, and usually found in the upper workings of mines.

Uses:—Chrysocolla is one of the so-called oxidized ores of copper.

CHRY SOLITE. (See Olivine.)

CHRY SOPRASE. (Blue-green Chalcedony.)

Locality:—Gila County, "blue chrysoprase" at Live Oak and Keystone mines, near Miami. Mohave County, true chrysoprase on west slope of River Range.

Distinguishing Features:—Apple green in color.

Blowpipe Tests:—See Chalcedony.

Occurrence:—See Chalcedony.

CINNABAR. (Native Vermilion.) HgS.

Locality:—Gila County, reported at Rye. Maricopa County. Yavapai County, reported at Skull Valley. Yuma County, sparsely distributed in veins at Cinnabar, 14 miles from Ehrenberg.

Distinguishing Features:—Cinnabar often occurs in minute crystals in cavities. The crystals are hexagonal, of variable habit. Cinnabar usually occurs disseminated through the rock and in massive and earthy forms. Prismatic cleavage. Even in massive varieties, reflections from minute cleavage planes may be seen. Hardness, 2.5. Sp. Gr., 8.0. Adamantine lustre. Scarlet to dark red; black when impure. Slightly setile. Streak cochineal red.

Blowpipe Tests:—Volatile if pure. In the closed tube with dry soda cinnabar gives a sublimate of metallic mercury (little drops when rubbed with a wire). Soluble (with difficulty) in nitric acid (HNO₃). Soluble in aqua regia.

Occurrence:—In stock work deposits, i. e. scattered through the rock in stringers, etc., rather than in distinct veins. Often associated with serpentine.

Uses:—Cinnabar is practically the only ore of mercury.

CLAY. (Brick.)

Locality:—Cochise County, clay made into common and front brick at Benson, Douglas and Naco. Coconino County, at Williams and Flagstaff. Maricopa County, small quantity dug at Snowflake. Pima County, at Tucson. Pinal County, at Florence. Santa Cruz County, at Nogales. Yavapai County, at Mayer and Prescott.

Distinguishing Features:—Clay occurs in beds which result from the decomposition of the feldspars and other silicates. Clay beds are composed in part of some hydrous aluminum silicate such as kaolinite, but usually with intermixed quartz, mica, undecomposed feldspar, oxides and sulphides of iron. Their properties and uses depend chiefly upon their composition. The clay industries include the manufacture of common brick, fire brick, paving brick and hydraulic cement, earthen ware, stoneware, porcelain, etc., etc.

CLAY. (China.) See Kaolin.

CLAY. (Fire, Graphitic.)

Locality:—Cochise County, mined in Whetstone mountains near Benson.

Distinguishing Features:—Burns white. Used for lining converters. Also used for the manufacture of pressed brick.

COAL. (Bituminous.)

Locality:—Pinal County, Deer Creek field, at the eastern end of the county, 35 miles southeast of Globe, and east of Winkelman; area 30 sq. miles; two workable beds, 24 to 30 inches; blocking and coking.

Distinguishing Features:—Bituminous coal ranks next to anthracite in the percentage of fixed carbon present, which varies from 75 to 90%. It is amorphous and compact, generally showing stratification; occasionally fibrous. Brittle. Brown to black in color. Brown to grayish brown streak. Vitreous, pitchy or greasy lustre. Conchoidal to cubical fracture. Hardness, 2 to 2.5. Sp. Gr., 1.15 to 1.5. Imparts no, or but a slight color to a solution of potassium hydroxide (canster potash). Burns with a yellow smoky flame.

Occurrence:—In beds which may be tilted or folded at varying angles.

Uses:—of great importance as fuel.

COAL. (Sub-bituminous.)

Locality:—Apache, Coconino and Navajo counties, black Mesa field, in Moqui and Navajo Indian reservations; area approximately

5920 square miles. Coal in two main groups of beds appear to be in thin benches alternating with layers of shale and bone.

Distinguishing Features:—Much the same as bituminous coal, except that it is less valuable as a fuel, containing a higher percentage of ash.

Occurrence:—See bituminous coal.

COPPER. (Native.) Cu.

Locality:—Cochise County, Bisbee district, with cuprite in Calumet & Arizona, Copper Queen and other mines. Gila and Pinal counties, Globe district, in Quartzite and Old Dominion mines. Greenlee County, with other copper ores in Metcalf mines, Clifton-Morenci district—not important. Yavapai County, in ores of Bradshaw Mountain district; not important.

Distinguishing Features:—Native copper is found in small disseminated grains, in sheets, and occasionally in large masses. Also arborescent and filiform. Copper has no cleavage. Ductile and malleable. Hardness, 2.5 to 3. Sp. Gr., 8.5 to 9. Metallic lustre. Copper red in color, often tarnished and also incrustated with alteration products such as cuprite and malachite. Streak copper red, metallic and shiny.

Blowpipe Tests:—Fusible at (3) to a malleable globule. Soluble in dilute nitric acid (HNO_3) to a green solution with the evolution of red fumes of NO_2 . Solution turns deep azure blue upon the addition of ammonia.

Occurrence:—(1) As a secondary mineral in many copper mines, formed by the reduction of copper compounds in solution, which in turn were formed by the oxidation of chalcopyrite. (2) In amygdaloidal cavities of diabase, associated with calcite, epidote, etc., and sometimes with silver.

Uses:—Important copper ore in some localities and of lesser importance in many districts.

CORONADITE. (Manganite of Lead.) (Rare.)

Locality:—Greenlee County, Clifton-Morenci district, fairly abundant near Coronado vein, three-quarters of a mile west of Horseshoe; said to contain some gold.

COVELLITE. (Indigo Copper, Blue Copper.) CuS .

Locality:—Greenlee County, rare in Clifton-Morenci district, in Ryerson and Montezuma mines.

Distinguishing Features:—The mineral usually occurs in compact, fine grained masses. Also as a coating and crust; in veinlets, reniform, and powdery. Perfect basal cleavage. Compact specimens

possess an even fracture. Thin plates are flexible. Hardness, 1 to 2. Sp. Gr., 4.6. Streak, black. Lustre, metallic, pearly to dull.

Blowpipe Tests:—Fusible at $2\frac{1}{2}$. In closed tube gives a sublimate of sulphur (distinction from chalcocite). On charcoal burns with a blue flame, giving off sulphur dioxide (SO_2) and leaves a button of copper. Soluble in nitric acid (HNO_3) to a green solution.

Occurrence:—A characteristic mineral of the zone of secondary enrichment. In many mines it occurs as an incrustation on chalcopryrite.

CROCITE. (Red Lead.) PbCrO_4 .

Locality:—Maricopa County, in some of the mines of the Vulture district. Pinal County, Mammoth mine. Occasionally met in other lead ores.

Distinguishing Features:—Occurs also in columnar and granular masses, sometimes in crusts. Distinct basal and prismatic cleavages. Conchoidal to uneven fracture. Sectile. Hardness, 2.5 to 3. Sp. Gr., 6.0. Translucent. Greasy, adamantine lustre. Various shades of red, resembles potassium dichromate in color. Orange yellow streak.

Blowpipe Tests:—Easily fusible (at $1\frac{1}{2}$) on charcoal, giving a metallic button. In closed tube turns dark and decrepitates. Imparts an emerald green color to the salt of phosphorous bead.

Occurrence:—Crocite is an alteration product of galena. Occurs as a secondary mineral in the gossam.

Uses:—Crocite does not occur abundantly enough to be of commercial importance.

CUPRITE. (Red Oxide of Copper.) (Ruby Copper.) Cu_2O .

Locality:—Cochise County, abundant and important ore of Bisbee district; in Calumet & Arizona and Copper Queen mines. Gila and Pinal counties, in Continental and Buffalo mines, Globe district. Greenlee County, in Clifton, Morenci and Metcalf mines. Yavapai County, Bradshaw Mountain district; not important.

Distinguishing Features:—Cuprite is found in crystals, in crystalline aggregates, and in fine grained masses. Crystals are isometric, the common forms being the cube, octahedron, and dodecahedron. Octahedral cleavage, not very pronounced. Conchoidal to uneven fracture. Brittle. Hardness, 3.5 to 4. Sp. Gr., 6.0. Metallic adamantine lustre on fresh surface; also submetallic to earthy. Color, dark red to brownish red. Translucent to opaque. Streak, brownish-red.

Blowpipe Tests:—On charcoal fuses at $2\frac{1}{2}$, to a copper button. Colors flame green. Soluble in acids and ammonia (NH_4OH).

Uses:—Cuprite is a valuable ore of copper on account of its high percentage of copper.

DESCLOIZITE. (Vanadate of Lead.) $(\text{PbZn})(\text{PbOH})\text{VO}_4$.

Locality:—Cochise County, Lucky Cuss mine, Tombstone, Castle Dome district. Mammoth mine in Catalina mountains; Old Yuma mine, Tucson mountains. Pinal County, Dripping Springs Range, four miles east of Kelvin, with vanadinite and wulfenite.

Distinguishing Features:—Usually possess drusy or warty surfaces; also massive. Hardness, 3.5. Sp. Gr., 6.0. Orange, brownish red, or grayish streak. Cherry to brownish red, light or dark brown, or black in color. Not a common mineral.

DUFRENOSYITE. (Arsenical Lead Ore.) $\text{Pb}_2\text{As}_2\text{S}_6$. (Rare.)

Locality:—Mohave County, associated with other ores of lead, zinc, silver; mined where argentiferous; Mineral Park.

Distinguishing Features:—Crystals usually large, thick, tabular or columnar, but rare. Striated, compact, massive. Basal cleavage. Brittle. Hardness, 3. Sp. Gr., 3.5 to 3.6. Dark lead gray color. Red brown streak.

Not common mineral.

DYSCRASITE. (Antimonide of Silver) $\text{Ag}_3\text{Sb}(\text{?})$

Locality:—Associated with other ores of lead and silver.

Distinguishing Features:—Also compact, granular, nodular, and as a coating. Good cleavage. Brittle. Uneven fracture. Hardness, 3.5. Sp. Gr., 9.6 to 10. Silver white, tarnished gray, black or yellow brown.

Blowpipe Tests:—Easily fusible on charcoal, yielding the antimony coating and a globule of silver.

Occurrence:—Occurs associated with silver, antimony, arsenic, and cobalt minerals.

Uses:—Valuable silver ore.

EMBOLITE. (Chlorobromide of Silver.) $\text{Ag}(\text{ClBr})$.

Locality:—Cochise County, especially abundant in Pearce district; occasionally found with other silver ores.

Distinguishing Features:—Crystals resemble those of cerargyrite. Usually massive. Sectile. Hardness, 1 to 1.5. Sp. Gr., 5.5. Yellow, grayish green, or yellowish green in color. The percentages of chlorine and bromine vary considerably.

FLUORSPAR. (Fluorite.) CaF_2 .

Locality:—Cochise County, a small quantity in quartz veins, four miles north of Dragoon. Mohave County, gangue mineral of Black Mountain. Yavapai County, gangue mineral of Bradshaw Mountain district. Yuma County, Castle Dome district. Pima County, Silver Bell district.

Distinguishing Features:—Fluorite usually occurs in cleavable masses, but also often in distinct crustals. The crystallization is isometric. One of the most important characteristics of fluorite is the perfect octahedral cleavage. On a cube this will show as triangular faces at the vertices, or at least as cracks in this direction. Hardness, 4. Sp. Gr., 3.2. Brittle. Usually yellowish, greenish, or blue in color; also various shades of red, brown, white, and colorless. Transparent to translucent. Vitreous lustre. Phosphoresces when heated.

Blowpipe Tests:—In the closed tube decrepitates. Fuses at 3 to a white enamel and colors flame red. Soluble in sulphuric acid (H_2SO_4) with evolution of HF (hydrofluoric acid) which etches glass.

Occurrence:—(1) As a vein mineral associated with galena, sphalerite, calcite and barite. (2) In tinstone veins associated with cassiterite, apatite, topaz, and lepidolite. (3) Limestones.

Uses:—The main use of fluorite is as a flux in iron smelting and foundry work. Minor uses are the manufacture of enamels, opalescent glass and hydrofluoric acid.

FREIESLEBENITE. (Antimonial sulphide of silver.) (PbAg_2) Sb_4S_{11} .

Locality:—Yuma County, mined at Castle Dome, with other argentiferous ores.

Distinguishing Features:—Monoclinic, prismatic class. Often striated. Twins. Compact and disseminated. Conchoidal fracture. Hardness, 2 to 2.5. Sp. Gr., 6.3. Lead to light steel gray, tarnishes black. Gray streak.

Occurrence:—With other argentiferous ores.

Uses:—Mined to some extent.

GADOLINITE. $\text{Fe}[\text{Be}(\text{Y.O})\text{SiO}_4]_2$. (Rare.)

Locality:—Mohave County, in pegmatite, 20 miles south of Hackberry.

Distinguishing Features:—Crystals, which are very rare, are usually rough and of a prismatic habit. Occurs more commonly in masses. No cleavage. Conchoidal fracture. Pitch to greenish black or brown

in color. Opaque; thin fragments are translucent and appear green to brown in transmitted light. Greenish gray streak. Hardness, to 7. Sp. Gr., 4 to 4.5. Vitreous to greasy lustre.

Blowpipe Tests:—When heated it glows without fusing. Gelatinizes with hydrochloric acid (HCl).

Occurrence:—Gadolinite is not a common mineral. It is found associated with allanite, fluorite, fergusonite, molybdenite, and other rare minerals; in pegmatitic veins.

Uses:—Gadolinite is a source of the oxides of some of the rare earths.

GALENA. (Sulphide of Lead.) PbS.

Locality:—Gila and Pinal counties, sparingly in Globe and Ray districts. Greenlee County, in Metcalf ores of Clifton-Morenci district. Mohave County, Chloride district; mined at Tennessee, Elkhart, Hercules and other mines; principal ore of Mineral Park district; mined at Tyler, Lady Bug, and Queen Bee mines, Cerbat district; Idaho and Alexander mines, Stockton Hill district. Pima County, Mammoth mine; Ridley mine, near Helvetia. Yavapai County, common silver mineral of Bradshaw Mountain district; Senator and other mines. Also occurs in Cochise, Santa Cruz and Yuma counties.

Distinguishing Features:—Well developed crystals common. Mostly in cleavable masses. Compact, granular, fine grained; rarely stactitic and fibrous. Very perfect cubical cleavage. Hardness, 2.5. Sp. Gr., 7.5. Metallic lustre, especially on cleavage surfaces; otherwise rather dull. Lead gray in color. Grayish black streak.

Blowpipe Tests:—Easily fusible at 2, giving on charcoal a malleable button, a yellow sublimate (PbO) near the assay, and a white sublimate (PbSO₄) farther from the assay. Decomposed by hydrochloric acid (HCl) with the separation of lead chloride (PbCl₂), a white crystalline precipitate soluble in hot water. Decomposed by nitric acid (HNO₃), with the separation of sulphur and PbSO₄.

Occurrence:—(1) As a vein mineral associated with sphalerite, chalcopryrite, pyrite, etc.; often with barite as a gangue mineral. (2) As a metasomatic replacement of limestone. (3) In sedimentary rocks such as limestones, shales, and sandstone. Often associated with sphalerite. The vein type of galena is usually argentiferous.

Uses:—Galena is the most important ore of lead; argentiferous galena is one of the most important silver ores.

GARNET. (Silicate of Calcium and Aluminum, etc.) R₂R₃(SiO₄)₃.

Locality:—Greenlee County, large masses on western slope of Modoc Point at Morenci, and on top of Shannon Mountain at Metcalf; massive garnet occurs in many of the mining districts; as yellowish to dark brown andradite at Clifton. Yavapai County, common in schists of Bradshaw mountains. Navajo Reservation, gem pyrope (Arizona ruby) in extreme northern part of the state, and with peridot 10 miles north of Fort Defiance.

Distinguishing Features:—Garnet is found in distinct crystals which are usually embedded, in compact or granular masses, and in the form of sand. Imperfect cleavage. Conchoidal to uneven fracture. Brittle. Hardness, 6.5 to 7.5. Sp. Gr., 3.4 to 4.6. The precious varieties are transparent, the others translucent to opaque. Vitreous to resinous lustre. White streak. Sometimes colorless, but usually colored, red, brown, yellow, green, and black. All colors, except blue, are to be observed.

There are six principal varieties of garnet with the general formula $R''_3R'''_2(\text{SiO}_4)_3$, in which R'' may be calcium, magnesium, manganese or iron, and R''' may be aluminum, iron or chromium.

The six varieties are:

GARNET. (Silicate of Calcium and Aluminum, etc.) $R''_3R'''_2$

Grossularite	$\text{Ca}_3\text{Al}_2(\text{SiO}_4)_3$
Pyrope	$\text{Mg}_3\text{Al}_2(\text{SiO}_4)_3$
Almandite	$\text{Fe}_3\text{Al}_2(\text{SiO}_4)_3$
Spessartite	$\text{Mn}_3\text{Al}_2(\text{SiO}_4)_3$
Andradite	$\text{Ca}_3\text{Fe}_2(\text{SiO}_4)_3$
Uvarovite	$\text{Ca}_3\text{Cr}_2(\text{SiO}_4)_3$

Blowpipe Tests:—All are fusible (3 to 4) except Uvarovite, which is infusible. Insoluble before fusion, but after fusion (alone, not with sodium chlorate (Na_2CO_3)) it gelatinizes with hydrochloric acid (HCl). (Except Uvarovite.)

Occurrence:—(1) In crystalline schists; (2) As a contact metamorphic mineral; (3) As a constituent of many eruptive rocks; (4) With various ore deposits; (5) In secondary deposits.

Uses:—Garnet is used as an abrasive, especially for finishing wood and leather. Some varieties are used for gems.

GLAUBERITE. (Sulphate of Soda and Lime.) $\text{Na}_2\text{SO}_4 \cdot \text{CaSO}_4$.

Locality:—Yavapai County, associated with thenardite, halite and mirabilite, Verde Valley.

Distinguishing Features:—Crystals are generally thick tabular. Occurs also in reniform and lamellar masses. Perfect basal cleavage. Conchoidal fracture. Hardness, 2.5 to 3. Sp. Gr., 2.8. Brit-

etc. Vitreous to greasy lustre. Colorless, white, gray, yellow, also flesh to brick red. White streak. Bitter saline taste.

Blowpipe Tests:—Fuses easily (1.5). When dissolved in water, gypsum ($\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$) is precipitated. Exposed to moist air the surface becomes coated with a crust of mirabilite ($\text{Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O}$). Colors flame intensely yellow. On charcoal in oxidizing flame fuses to a clear bead. Soluble in hydrochloric acid. (HCl).

Occurrence:—In crystals associated with halite (rock salt) thenardite and mirabilite.

GOLD. (Lode.) Au.

Locality:—Principal producers are Cochise County, Warren and Tombstone districts. Mohave County, San Francisco district. Yavapai County, Big B Bug, Martinez, Tiger and Verde districts. Yuma County, Kofa district.

Distinguishing Features:—Crystals are usually small, more or less distorted, and possess dull faces. Most common occurrence is as disseminated scales or grains. Malleable and ductile metal. No cleavage; hackly fracture. Hardness, 2.5 to 3. Sp. Gr., 15.6 to 19.3. Metallic lustre. Golden, brassy, to light yellow in color and streak. Pale yellow varieties contain silver.

Blowpipe Tests:—Fusible at 3. Forms amalgam with mercury. Soluble in aqua regia, the silver bearing varieties leaving a white residue of silver chloride (AgCl).

Occurrence:—(1) In quartz veins along with pyrite, rhaluopyrite, sphalerite, arsenopyrite, etc. (2) As a secondary mineral in gossam.

Uses:—The uses of gold are well known.

GOLD. (Placer.)

Locality:—Pima, Yavapai and Yuma counties are the largest producers. Other counties yielding appreciable quantities are Cochise, Coconino, Gila, Greenlee, and Santa Cruz. Dredges have been erected on the Lynch Creek in the Walker district, Yavapai County, and in French Gulch, a small tributary of the Hassayampa River. Other important placers are in Pima County at Greaterville, at Cana del Oro, Catalina mountains. Weaver placers in Yavapai County. (See Bulletin No. 10, "Gold Placers of Arizona," Arizona State Bureau of Mines.)

Distinguishing Features:—Placer gold is the result of the disintegration of the rocks containing gold in place, that is, disseminated or in veins. The gold, because of its high specific gravity, becomes concentrated in the stream beds and is found as scales, grains, and nuggets. Physical features and tests are the same as for gold (lode).

GRANITE.

Locality:—Quarried in Cochise County, at Lee Station. Gila County, at Globe. Maricopa County, at Phoenix. Occurrence is widely distributed.

Distinguishing Features:—Granite is a medium to coarse-grained and light-colored rock, having an even texture and consisting chiefly of quartz and feldspar. Frequently both orthoclase and usually small amounts of mica or hornblende are present. The feldspar can be recognized by the color and cleavage. Frequently the orthoclase is colored flesh color, or red while the soda-lime feldspar is usually white. The quartz is recognized by its glassy lustre and conchoidal fracture. It is usually white or smoky gray in color, and is found in irregular grains filling up the intersices between the other minerals. The mica, which may be either muscovite (pale green or brown) or biotite (black) is to be recognized by its cleavage. Granite is a common rock type.

GRANITE. (Quartz Diorite.)

Locality:—Gila County, Pinal Range. Yavapai County, Bradshaw Mountains.

This variety of granite makes a good building stone.

GRAPHITE.

Pure graphite has not been found. See Clay (Graphitic).

GYPSUM. (Satin Spar, Alabaster.) $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$.

Locality:—Cochise County, quarried at Douglas. Greenlee County, Clifton-Morenci district. Navajo County, used for manufacture of plaster in Fort Apache Reservation, Woodruff and Snowflake. Pima County, occurs in Santa Rita mountains, Sierrita mountains, and Santa Catalina mountains; quarried near Tucson; Cochise and Pinal counties, San Pedro Valley; Yavapai County, Verde Valley.

Distinguishing Features:—Crystals are usually rather simple and either tabular or prismatic in habit. Also occurs massive, coarse and fine, granular, fibrous, foliated, earthy and as sand. Perfect cleavage in one direction, fibrous cleavage in another direction, and conchoidal cleavage in a third direction. Hardness, 1.5 to 2. Sp. Gr., 2.3. Colorless, white, amber, gray, pink, yellow, brown, or black. Lustre, vitreous pearly or silky. White streak.

Blowpipe Tests:—Easily fusible at (3) to a white enamel, giving a yellow-red flame. In the closed tube becomes opaque and gives off water at a low temperature. Easily soluble in hydrochloric acid (HCl) (distinction from anhydrite). Soluble in hot potassium hydroxide (KOH).

Occurrence:—(1) In bedded deposits, associated with salt and limestone and formed directly by the evaporation of inland seas. (2) As a secondary mineral in various rocks. (3) As a hydration product of anhydrate.

Uses:—Gypsum is used extensively in the manufacture of plaster and as a fertilizer.

HALITE. (Common Salt.) NaCl .

Locality:—Gila County, occurs along Salt River and in Tonto Basin. Yavapai County, occurs in Verde Valley.

Distinguishing Features:—Halite occurs in crystals, and in cleavable, granular and fibrous masses. Crystals are isometric, usually cubes, sometimes hopper shaped, rarely in octahedrons. May be stalactitic. Excellent cubical cleavage. Conchoidal fracture. Brittle. Hardness, 2 to 2.5. Sp. Gr., 2.2. When pure, colorless; due to impurities, may be reddish, blue, gray, greenish, or black. Saline taste. Vitreous lustre. Transparent to translucent.

Blowpipe Tests:—Fuses easily at (1), giving an intense yellow flame. With copper oxide (CuO) in vanadium phosphate (VaPO_4) bead gives an azure blue flame. Soluble in water.

Occurrence:—Occurs in beds associated with anhydrite, gypsum, and occasionally with other chlorides and sulphates.

Uses:—Halite is the chief source of sodium compounds used principally in the manufacture of soap and glass. It is also used extensively as table salt and as a preservative. Salt brines furnish bromine.

HEMATITE. (Red Iron Ore, Specular Iron Ore.) Fe_2O_3 .

Locality:—Red iron occurs in gossan of copper deposits at many localities. In Santa Cruz County, at Pluto, Isabella, and other claims. In Yuma County, at Palmer and Wharton claims; occurs as a contact mineral in Cochise County in magnetite on croppings of Black Diamond mine, Dragoon. In Greenlee County, Clifton-Morenci district; and at Manganese blue mine. In Gila County, mined with copper ores in the Globe district. Micaceous hematite has been reported from Willcox and Briggs, Yavapai County. Specular iron in Gila County with chalcopyrite in Old Dominion, Superior & Boston, Gibson and other mines of Globe district. In Mohave County is common in Black Mountain and Cerbat Range, Chloride district. Pinal County, occurs near Mammoth. Santa Cruz County, at the Line Boy, near Duquesne.

Distinguishing Features:—Hematite is found in a variety of forms—as small hexagonal crystals; more abundantly in compact, granular, micaceous, earthy, columnar, fibrous, botryoidal, reniform, and

stalactitic masses. No cleavage. Conchoidal to uneven fracture. Hardness, 5.5 to 6.5—earthy varieties are very soft. Sp. Gr., 5.2. Metallic lustre, splendid or dull. Steel gray to iron black in color. Streak is cherry red or reddish brown. Sometimes slightly magnetic.

Blowpipe Tests:—Fusible with difficulty at 5.5. On charcoal reducing flame becomes magnetic. Gives green borax bead. Slowly soluble in concentrated hydrochloric acid (HCl).

Occurrence:—(1) As a metasomatic replacement of cherty iron carbonate. (2) As an alteration product of other iron minerals. (3) As a pigment in many minerals and rock, giving a red color.

Uses:—Hematite is the chief source of the iron of commerce. About 90% of the iron ore mined annually is hematite.

HUBNERITE. (Ore of Tungsten.) $(\text{Mn}, \text{Fe})\text{WO}_4$.

Locality:—Cochise County, in veins and placer deposits near Dragoon. Pima County, in quartz veins cutting granite, at Arivaca.

Distinguishing Features:—Hubnerite usually occurs in long, fibrous, bladed crystals or crystalline aggregates. Brownish red, brownish black, pale yellow or nearly black in color; in transmitted light ruby red to yellow. Streak, yellowish brown to greenish gray. Vitreous to resinous lustre. Hardness, 4.5 to 5.5. Sp. Gr., 6.7 to 7.3. Perfect cleavage. Often translucent.

Blowpipe Tests:—Fusible at 4. Gives the manganese bead tests (borax bead becomes brown in reducing flame). Insoluble in acids. The soda fusion gives a yellow residue (WO_3) with HCl.

Occurrence:—A vein mineral associated with scheelite.

Uses:—Hubnerite is an important ore of tungsten.

JAMESONITE. $\text{Pb}_4\text{FeSb}_4\text{S}_{12}$.

Locality:—Yavapai County, occurs in ores of Bradshaw mountains.

Distinguishing Features:—Jamesonite occurs in delicate capillary crystals and in columnar and compact masses. Cleavage in one direction transverse to the length of the crystals. Easily broken. Hardness, 2.5. Sp. Gr., 5.7. Lead-gray in color with metallic lustre. Streak, gray to black.

Blowpipe Tests:—On charcoal easily fusible at 1, giving white and yellow coating. In closed tube gives a yellow sublimate of sulphur and a dark red sublimate of antimony sulph-oxide, nearly black when hot. With soda on charcoal gives a lead button. Soluble in hydrochloric acid (HCl) with the evolution of hydrogen sulphide (H_2S). On cooling the solution, needle crystals of lead chloride (PbCl_2) separate. Decomposed by nitric acid (HNO_3) with the separation of a white residue.

Occurrence:—As a vein mineral.

JASPER. (Impure Quartz.)

Locality:—Mohave County, on west slope of River Range, 20 miles west of Mineral Park. Yuma County.

Distinguishing Features:—Opaque, red, yellow, dark green and grayish blue varieties. When the colors are in broad bands or stripes, it is called riband or striped jasper.

Blowpipe Tests:—See Quartz.

Occurrence:—See Quartz.

KAOLIN.

Locality:—Gila County, occurs at Globe, Greenlee County; not uncommon at Copper Queen, Morenci and Metcalf, Clifton-Morenci district; as veinlets in quartz in Humboldt, Ryerson, and other mines; mined at Longfellow for converter lining. Pinal County, in Vekol mines.

Distinguishing Features:—The usual occurrence of kaolin is in clay-like masses. Hardness, 1, or higher. Sp. Gr., 2.6. White, grayish yellow, bluish, reddish, brownish or greenish in color. Greasy feel; white to yellow streak. Usually adheres to the tongue and becomes plastic when moistened with water. Lustre, pearly to dull.

Blowpipe Tests:—Infusible if pure. Heated with cobalt nitrate solution it becomes deep blue. In the closed tube gives water. Insoluble in acids.

Occurrence:—(1) As a secondary mineral formed from the feldspar either by carbonated waters or by pneumatolysis. (2) In sedimentary rocks formed by the alteration of aluminous silicates.

Uses:—Kaolin is used in the manufacture of porcelain, china and pottery.

LEADHILLITE. (Carbono-sulphate of Lead.) $\text{PbSO}_4 \cdot 2\text{Pb CO}_3 \cdot \text{Pb (OH)}_2$.

Locality:—Pinal County, rare; occurs with other lead ores at Schults.

Distinguishing Features:—Hardness, 2.5. Sp. Gr., 6.4. Rather sectile. Pearly or resinous adamantine lustre. Generally yellow, gray, greenish, or brown in color, rarely colorless. White streak. Transparent to translucent.

Blowpipe Tests:—Fuses easily with intumescence. Turns yellow and when cold is white. Is easily reduced on charcoal to metallic lead. With soda on charcoal reacts for sulphur. Yields water in closed tube. Soluble in nitric acid (HNO_3) with effervescence, leaving a white residue of lead sulphate.

Occurrence:—Is usually associated with lead minerals.

LIMESTONE. CaCO_3 .

Locality:—Cochise County, quarried for building or lime at Lee Station. Coconino County, at Flagstaff. Gila County, quarried during construction of dam at Roosevelt. Greenlee County, gray Modoc limestone quarried at Morenci. Yavapai County, at Wekon.

Distinguishing Features:—Limestone includes many massive varieties of calcite which (1) may be dull or compact; (2) coarse or fine granular, and (3) composed of fragmental material. The color may be white, yellow, bluish gray, reddish or black. Hardness, 3. Sp. Gr. 2.7. Vitreous lustre; also earthy. Streak, white.

Blowpipe Tests:—Infusible before the blowpipe becomes glowing hot. Imparts red color to flame. Easily soluble with brisk effervescence in cold dilute acids.

Occurrence:—Secondary rock formed from secretions of calcium carbonate (CaCO_3) by minute marine organisms.

Uses:—Building stone, lithographic purposes, as a source of lime, etc., etc.

LIMONITE. (Brown Hematite; Bog Iron Ore.) $\text{Fe}_2\text{O}_3 \cdot (\text{OH})_3$

Locality:—Cochise County, Copper Queen mine at Bisbee. Gila and Pinal counties, mined for copper contained in Old Dominion mine, Globe district. Mohave County, in ores of Black Mountains and Cerbat Range, Chloride district. Pima County, coating quartz veins at McCleary prospects near Helvetia. Yavapai County, in ores of Bradshaw mountains.

Distinguishing Features:—Limonite nearly always occurs in compact, porous or earthy masses. Radial fibrous structure and black varnish-like surface are characteristic features. Also concretionary, conchoidal or earthy fracture. Hardness, 5.5. Sp. Gr., 3.8. Color, yellow, brown, or black. Streak, yellowish brown. Lustre, submetallic to dull.

Blowpipe Tests:—Thin splinters fuse to a magnetic globule. In closed tube turns red and gives off water. Green borax bead. Soluble in hydrochloric acid (HCl).

Occurrence:—(1) As a secondary mineral in veins and ore deposits formed by the oxidation of pyrite. (2) As a metasomatic replacement of limestone. (3) As bog iron formed by the oxidation of $\text{FeH}_2(\text{CO}_3)_2$ which is in solution in marshes. (4) As a pigment and stain in various rocks.

Uses:—Limonite is an important ore of iron.

MAGNETITE. (Magnetic Iron Ore. Fe_3O_4 .)

Locality:—Cochise County, Black Diamond mine, Dragoon Range.

Greenlee County, Clifton-Morenci district. Yavapai County, in ores of Bradshaw mountains.

Distinguishing Features:—Magnetite occurs in loose and attached crystals, in compact and granular masses, and in the form of sand. No distinct cleavage. Excellent octahedral parting is often observed. Conchoidal to uneven fracture. Brittle. Hardness, 6. Sp. Gr., 5.1. Metallic, sub-metallic or dull lustre. Iron black in color. Black streak. Opaque. Strongly magnetic.

Blowpipe Tests:—Fuses with difficulty at 5.5. Gives bead tests for iron (green borax bead). Soluble in concentrated hydrochloric acid (HCl).

Occurrence:—(1) A very common and widely distributed accessory constituent of igneous rocks. (2) In ore deposits due to magmatic segregation. (3) As a contact mineral between igneous rocks and limestones, often occurring with pyrite. (4) In lenses and layers in schists and gneisses. (5) As an alteration product of iron-bearing silicates in altered igneous rocks. (6) As the main constituent of the so-called black sands which are prominent on the Pacific coast.

Uses:—Magnetite is an important ore of iron.

MALACHITE. (Green Carbonate of Copper.) $\text{Cu}_2(\text{OH})\text{CO}_3$.

Locality:—Cochise County, mined at Bisbee, Copper Queen and other mines. Greenlee County, common in irregular deposits in limestone in Clifton-Morenci district; mined at Detroit, Manganese Blue, Longfellow, and Standard mines. Gila and Pinal counties, abundant in Globe district, associated with copper ores, but not itself an important ore constituent. Mohave County, in granite gneiss, Mineral Park district. Yavapai County, in ores of Bradshaw mountains.

Distinguishing Features:—For malachite the characteristic occurrences are mammillary crusts, fibrous masses, and acicular crystals. Good cleavage; conchoidal fracture. Brittle. Hardness, 3.5 to 4. Sp. Gr., 3.9. Bright emerald green, grass green to nearly black in color. Light green streak. Translucent to opaque. Adamantine, silky or dull lustre.

Blowpipe Tests:—Easily fusible at 3, giving a green flame, which is made blue by hydrochloric acid (HCl). In the closed tube it turns black and gives off water (H_2O). Soluble in acids with effervescence.

Occurrence:—As a secondary mineral in the upper oxidized zone of copper deposits. Often associated with azurite.

Uses.—An ore of copper. Polished malachite is used as ornamental stone.

MARBLE. CaCO_3

Locality.—Cochise County, near Fort Bowie, near Emigrant Canyon and near Whitetail Canyon. Pima County, black marble in Tucson mountains. Pinal County, white statuary marble at northern end of Catalina mountains, near Condon mine. Yavapai County, near Mayer, Bradshaw mountains.

Distinguishing Features.—Marbles are altered limestones which are capable of taking a polish and which are suitable for ornamental and structural purposes. They are usually crustalline and fine to coarse granular.

For tests and occurrences, see limestone.

MELACONITE. Black Oxide of Copper.) CuO .

Locality.—Of common occurrence with other ores of copper.

Distinguishing Features.—Melaconite is found massive or earthy, sometimes in crystalline scales. Commonly found as a coating on copper minerals. The crystals are called tenorite; the earthy masses, melaconite. Steel gray to black in color. Hardness, 3 to 4. Sp. Gr., 6 (variable). Dull or earthy lustre.

Blowpipe Tests.—Infusible. Gives flame and bead tests for copper. Soluble in nitric acid (HNO_3) to a green solution.

Occurrence.—As a secondary mineral in the oxidized zone of copper mines.

Uses.—Minor ore of copper.

MICA. (See Muscovite.)

MIRABILITE. (Soluble Sulphate of Soda.) $\text{Na}_2\text{SO}_4 \cdot 10 \text{H}_2\text{O}$.

Locality.—Yavapai County, associated with thenardite, glauberite, and halite, Verde Valley.

Distinguishing Features.—Crystals rare. Usually occurs as a mealy efflorescence or in crusts, sometimes with a fibrous structure. Perfect orthopinacoidal cleavage. Hardness, 1.5 to 2. Sp. Gr., 1.5. Vitreous lustre. Colorless and transparent. On exposure to air loses water, turns white, and falls to powder. Cooling, salty, bitter taste.

Blowpipe Tests.—Easily fusible at 1.5, giving an intense yellow flame. In the closed tube gives abundant water. Soluble in water.

Occurrence.—In soda lakes. (2) As an efflorescence in caves and other protected places.

MOLYBDENITE. (Molybdenum Disulphide.) MoS_2 .

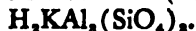
Locality.—Gila County, in disseminated ores at Miami. Greenlee County, in copper ores of Clifton-Morenci district; Mohave County, primary ore of Chloride district in granite-gneiss; with copper in Hualpai mountains, Maynard district. Pima County, in Madera Canyon, 10 miles southwest of Helvetia; at Leader and Ridley mines, Helvetia; with copper ores at Vail. Pinal County, in ores at Ray and Kelvin mines. Santa Cruz County, in granite at Providencia Canyon, 5 miles west of Washington; also at Duquesne and San Antonia Canyon. At Gold Bullions mines in Babaroquivai Range.

Distinguishing Features.—Molybdenite is usually found in foliated masses or in disseminated scales. Excellent basal cleavage. Flexible, greasy. Marks paper. Blue gray in color (graphite is black). Hardness, 1 to 1.5. Sp. Gr., 4.7. Gray streak on paper, on glazed porcelain greenish (graphite shiny black).

Blowpipe Tests.—Infusible. On charcoal gives a white sublimate which is copper red near the assay. Green sodium phosphate (NaPO_3) bead in reducing flame, colorless in oxidizing flame. Decomposed by nitric acid (HNO_3) with the formation of a white sublimate (MoO_3) which is soluble in NH_4OH (ammonia).

Occurrence.—(1) In pegmatites and surrounding rocks, especially granite. (2) In tinstone veins with cassiterite, wolframite, topaz, etc. (3) As a contact mineral between limestones and granites associated with epidote, chalcopyrite, etc.

Uses.—Source of molybdenum, which is used as an alloy with steel.

MUSCOVITE. (White Mica; Potash Mica; Isinglass)

Locality.—Several deposits, none developed, value unknown. Occurs in Coconino County, on the north side of Grand Canyon. Maricopa County, White Horse Tank mountains, southwest of Phoenix. Yuma County, in Mohawks.

Distinguishing Features.—Muscovite usually occurs in cleavages and scaly masses and but rarely in well-defined crystals. The crystals are tabular in habit. Highly perfect cleavage parallel to the basal pinacoid, permitting very thin, elastic leaves to be split. Hardness, 2 to 3. Sp. Gr., 2.8. Transparent to translucent. Pearly to metallic lustre. Colorless, when pure, but usually yellowish, brownish, greenish, or reddish. Uncolored streak.

Blowpipe Tests.—Fusible on thin edges at (5) and whitens. In

the closed tube it gives a little water. Insoluble in acids and not decomposed by sulphuric acid (H_2SO_4).

Occurrence.—(1) In granite-pegmatites and granite-apatites. (2) In schists and gneisses, often the main constituent of the mica-schists. (3) In granites as original constituent. (4) In sandstones and sands as a detrital mineral. (5) As a secondary mineral derived from other silicates, especially the feldspars.

Uses.—Muscovite is used principally as an insulator for electrical apparatus but has numerous other uses.

OBSIDIAN. (Volcanic Glass.)

Locality.—Occurs in regions of Tertiary rocks.

Distinguishing Features.—Obsidian is sometimes called volcanic glass. It is the best type of the compact, glassy rocks. It is essentially a natural glass, formed usually of acid silicates. It has the close texture, conchoidal fracture, and other qualities of glass. It is usually black, but sometimes red, brown, purple, bluish, or gray.

OLIVINE. (Chrysolite; Peridot.) $(Mg,Fe)_2SiO_4$.

Locality.—Apache County, 10 miles north of Fort Defiance, in the Navajo Indian Reservation. Gila County, in basaltic rocks near Rice, in the San Carlos Indian Reservation.

Distinguishing Features.—Occurs in loose, rounded, and disseminated grains and granular aggregates. Brittle. Hardness, 6.5 to 7. Sp. Gr., 3.2 to 3.6. Vitreous lustre, greasy on fracture surfaces. Transparent to translucent. Olive to grayish green, brown. Un-colored or slightly yellowish streak.

Blowpipe Tests.—Infusible; rather slowly soluble in hydrochloric acid (HCl) and yields gelatinous silica upon evaporation.

Occurrence.—Olivine is an essential constituent of many basic igneous rocks. It is sometimes found in crystalline limestone, the result of metamorphism.

Uses.—Transparent varieties are often used for gem purposes.

ONYX MARBLE. (Mexican Marble.)

Locality.—Maricopa County, at Cave Creek, 45 miles north of Phoenix. Pima County, at Greterville, Kirkland Valley and Oak Creek. Yavapai County, at Big Bug Creek.

Distinguishing Features.—Compact, banded appearance.

Blowpipe Tests.—See limestone.

Occurrence.—Onyx marble is formed by deposition around springs and in stream beds.

Uses.—Ornamental stone.

OPAL

Locality.—Pinal County, Pichett Post. Yavapai County, several localities.

Distinguishing Features.—Amorphous. Usually occurs compact, in veins or masses of irregular outline. Also loose and more or less earthy, sometimes stalactitic or reniform. Characteristic conchoidal fracture. Hardness, 5.5 to 6.5. Sp. Gr., 2.2. Vitreous, dull or greasy lustre. Transparent to opaque. Streak, white. Color varies greatly; may be white, yellow, brown, red, green, gray, etc. Often a play of colors is to be observed.

Blowpipe Tests.—Infusible. Insoluble in acids. Soluble in hot caustic potash or soda. Reacts like quartz; yields water when heated in closed tube.

Occurrence.—Opal is found lining and filling cavities in igneous and sedimentary rocks where it has been deposited through the agency of hot waters.

Uses.—There are several varieties of opal. Precious and fire opals are used for gem purposes; wood opal for ornamental purposes. Infusorial earth is used largely in polishing powders, scouring soaps, as an absorbent of nitroglycerine, etc.

PLATINUM. Pt.

Locality.—Yavapai County, occurs in black sands near Columbia.

Distinguishing Features.—Crystals very rare. Usual occurrence is in scales, grains, or nuggets. Metallic lustre; opaque. No cleavage. Hackly structure. Hardness, 4 to 6. Sp. Gr., 14 to 19. Malleable, ductile, sectile. Color is silvery white to dark gray or almost black. May be magnetic, especially if considerable iron is present. Platinum is usually alloyed with several per cent of iron and smaller amounts of iridium, osmium, etc.

Blowpipe Tests.—Infusible in ordinary blowpipe flame. Unattacked by ordinary reagents. Soluble in aqua regia. Determined by its high Sp. Gr. infusibility and insolubility.

Occurrence.—(1) In placers. (2) In veins with gold. (3) Disseminated in eruptive rocks.

Uses.—Platinum is used in the manufacture of various scientific instruments, such as crucibles, dishes, etc.; in photography, dentistry, etc.

POLYBASITE. (Sulphide of Silver and Antimony.)

(Ag,Cu) SbS₃

Locality.—Pinal County, fine specimens found at Silver King mine; occasionally with other argentiferous ores.

Distinguishing Features:—Uneven fracture. Hardness, 2 to 2.5. Sp. Gr., 6 to 6.25. Metallic lustre. Iron black. Thin splinters in transmitted light are cherry red. Black streak.

Blowpipe Tests:—Fusible at 1. On charcoal gives dense white coating of antimony trioxide with odor of sulphur dioxide. The residue reacts for copper and silver. (White precipitate with hydrochloric acid from nitric acid solution.)

Occurrence:—As a vein mineral, usually due to secondary enrichments.

Uses:—An ore of silver.

PROUSTITE. (Light Ruby Silver.) Ag_3AsS_3 .

Locality:—Occurs with other argentiferous ores at many places.

Distinguishing Features:—Conchoidal fracture. Brittle. Hardness, 2.5. Sp. Gr., 5.6. Brilliant adamantine lustre. Translucent to transparent. Color and streak scarlet to vermillion.

Blowpipe Tests:—Fusible at 1. Heated on charcoal gives volatile sublimate of arsenous oxide with characteristic garlic odor. In open tube gives odor of sulphur dioxide. In closed tube gives abundant sublimate of arsenic sulphide, reddish black when hot, reddish yellow when cold; with sodium carbonate (NaCO_3) on charcoal gives a globule of silver.

Occurrence:—As a vein mineral, often formed by secondary enrichment.

Uses:—An important ore of silver.

PSILOMELANE. (Manganese Ore.) Chiefly MnO_2 .

Locality:—Cochise County, with pyrolusite and wad in carboniferous limestone at Tombstone.

Distinguishing Features:—Occurs only in botryoidal, reniform, or stalactitic mass, usually with a smooth surface and at times with an apparently fine fibrous structure. Dark to iron black in color. Brownish black streak. Dull or sub-metallic lustre. Hardness, 5 to 6. Sp. Gr., 3.7 to 4.7. Brittle. Opaque. It is doubtful whether psilomelane is an independent mineral or not.

Blowpipe Tests:—Infusible. A small amount of mineral fused in oxidizing flame with sodium carbonate gives an opaque bluish green bead. Gives much water in closed tube. Evolves chlorine when treated with hydrochloric acid (HCl).

Occurrence:—Occurs with other manganese ores, limonite, barite, etc.

PYRARGYRITE. (Dark Ruby Silver.) Ag_3SbS_3 .

Locality:—Mohave County, secondary ore of Chloride, Mineral

Park, and Cerbat district; large quantities were found in upper levels of Stockton Hill district; mined at Minnesota-Connor, Golden Star and Paymaster mines. Yavapai County, in silver ores of Bradshaw mountains.

Distinguishing Features:—Occurs compact, disseminated, as a coating and dendritic. Imperfect pyramidal cleavage. Conchoidal to splintery fracture. Somewhat brittle. Hardness, 2.5 to 3. Sp. Gr., 5.85. Metallic adamantine lustre. In reflected light, dark red to lead gray in color; in transmitted light, deep red. Transparent only in thin splinters. Purple or cherry red streak.

Blowpipe Tests:—Fusible at 1. On charcoal gives dense white coating of antimony trioxide. After prolonged heating, coating becomes tinged with a reddish color near assay due to a small amount of volatilized silver. Odor of sulphur dioxide and coating of antimony oxides when heated in open tube. Decomposed by nitric acid (HNO_3). On addition of hydrochloric acid (HCl) white precipitate of silver chloride forms.

Occurrence:—As a vein mineral, similar to proustite. Sometimes associated with other silver ores, calcite, galena, etc.

Uses—An important ore of silver.

PYRITE. (Iron Sulphide.) FeS_2 .

Locality:—Common and widely distributed, generally in close association with copper sulphides. Cochise County, with copper ores of Bisbee mines, and others. Gila and Pinal counties, abundant in unenriched parts of nearly all copper deposits near Globe, Miami and Ray. Greenlee County, unimportant ore of Clifton-Morenci district; large masses in Joy, Ryderson, Morenci and other mines. Mohave County, primary ore at Tennessee, Schuykill, Windy Point, Keystone, Vanderbilt, and Idaho mines. Pima County, important ore in Mammoth mine; also in Leader and Ridley mines. Santa Cruz County, at Providencia Canyon, 5 miles west of Washington, and at Duquesne. Yavapai County, in ores of Bradshaw mountains; also at United Verde mine, Jerome district.

Distinguishing Features:—Crystals common and often very large. Also massive and disseminated. Fine grained, granular, reniform, globular, stalactitic, radiated. Imperfect cubical cleavage. Conchoidal fracture. Hardness, 6 to 6.5. Sp. Gr., 4.9 to 5.2. Brittle. Metallic lustre. Opaque. Pale brassy to golden yellow in color, sometimes with brown or variegated tarnish colors. Greenish to brownish black streak.

Blowpipe Tests:—Easily fusible, at 2.5 to 3, to a magnetic globule. Yields much sulphur in closed tube. Gives off sulphur dioxide in

open tube or before blowpipe, on charcoal. Insoluble in hydrochloric acid (HCl). Fine powder completely soluble in nitric acid (HNO_3), but may yield separated sulphur when too rapidly decomposed.

Occurrence.—(1) As common vein mineral in rocks of all ages and associated with many different minerals. (2) Pyrite is widely distributed accessory rock mineral in both igneous and sedimentary rocks.

Uses.—Pyrite is used principally as a source of sulphur dioxide in the manufacture of sulphuric acid by the chamber process, and also for sulphate of iron. Small quantities are also used as a mineral paint.

PYROLUSITE. (Black Oxide of Manganese.) MnO_2 .

Locality.—Cochise County, at Tombstone. Yavapai County, in ores of Bradshaw mountains.

Distinguishing Features.—Pseudomorphous after various manganese minerals. It is commonly found compact, fibrous, massive, stalactitic, dendritic, etc. Hardness, 1 to 2.5. Soils the fingers. Sp. Gr., 4.7 to 4.86. Black or bluish black streak. Black, dark steel gray, or bluish in color. Opaque.

Blowpipe Tests.—Infusible, turns brown when heated. A small amount of powdered mineral gives in oxidizing flame a reddish violet bead with borax, or a bluish green opaque bead with sodium carbonate (NaCO_3). Gives oxygen in closed tube which will cause a glowing splinter of wood to burst into flame when placed in the tube above the mineral. Yields some water in closed tube. In hydrochloric acid (HCl) chlorine is evolved.

Occurrence.—As a secondary mineral in many forms.

Uses.—Most important manganese ore. Pyrolusite is used in the manufacture of chlorine, bromine, oxygen, and spiegeleisen; as a coloring agent in calico-printing, and dyeing, glass, pottery, brick, and paints, and as a decolorizer of green glass.

PYROMORPHITE. (Phosphate of Lead.) $\text{Pb}_3\text{Cd}(\text{PO}_4)_3$.

Locality.—Occasionally found with other lead ores. Occurs in Yuma County, at Iber-Plomosa mine, Bouse; reported in Pima County, at Cerro-Colorado mine, and in Santa Cruz County at Constitution mine.

Distinguishing Features.—Occurs in botryoidal and reniform aggregates, disseminated, and in crusts. Conchoidal to uneven fracture. Brittle. Hardness, 3.5 to 4. Sp. Gr., 6.9 to 7.1. Greasy, adamantine lustre. Translucent to opaque. White to pale yellow

streak. Usually some shade of green in color, but may be yellow, gray, brown, orange or white.

Blowpipe Tests.—Easily fusible at (2). Gives a lead globule when fused on charcoal with soda. When fused alone on charcoal gives a globule which on cooling shows crystalline structure. Faint drops of nitric acid (HNO_3) solution added to ammonium molybdate white sublimate of lead chloride when heated in closed tube. A few drops of nitric acid solution added to ammonium solution gives a yellow precipitate of ammonium phospho-molybdate.

Occurrence.—Pyromorphite is formed by secondary action and is found in the upper oxidized portions of lead veins, associated with other lead minerals.

Uses.—A subordinate ore of lead.

PYRRHOTITE. (Magnetic Pyrite.) FeS .

Locality.—Yavapai County, in ores of Bradshaw mountains.

Distinguishing Features.—Well developed crystals not common. Usually massive and without cleavage. Often granular. Brittle. Hardness, 3.5 to 4. Sp. Gr., 4.6. Metallic lustre. Opaque. Bronze yellow to bronze red in color. Tarnishes to a dark brown. Streak, grayish black. Magnetic, sometimes only slightly.

Blowpipe Tests.—Fuses at 3, to a magnetic globule, giving fumes of sulphur dioxide (SO_2). In closed tube gives little or no sulphur. (Distinction from pyrite.) Soluble in nitric acid (HNO_3). Decomposed by hydrochloric acid (HCl), yielding hydrogen sulphide.

Occurrence.—(1) In basic igneous rocks. Some large deposits are due to magmatic segregation. (2) As a vein mineral. (3) In crystalline limestone. (4) Also found in meteorites in small quantities.

Uses.—Pyrrhotite often contains small amounts of cobalt and nickel and is an important source of these two metals.

QUARTZ. SiO_2 .

Locality.—Quartz is very common and is widely distributed. It often carries minerals of value. At the Easter Sunday mine in Co-chise County it was formerly mined for use as converter lining.

Distinguishing Features.—Crystals are very common. There are crystalline aggregates of various kinds as well as massive, granular, and compact varieties. Conchoidal fracture is highly characteristic. Brittle. Hardness, 7. Sp. Gr., 2.66. Vitreous lustre, sometimes slightly greasy on fracture surfaces. Transparent to opaque. When pure, quartz is colorless. Various shades of gray, yellow, red, blue,

green, brown and black are commonly noted. Many colors disappear when heated. Streak is white.

Blowpipe Tests:—Infusible even on thinnest edges. When fused with an equal volume of soda, it effervesces, and gives a colorless glass. Insoluble in sodium phosphate (NaPO_3) bead. Insoluble in ordinary acid. Soluble in hydrofluoric acid (HF).

Occurrence:—(1) As a normal constituent of the acid igneous rocks (rhyolites and granites). (2) As an abnormal constituent of the basic igneous rocks, especially basalts. (3) As a vein mineral, often the gangue of ores. (4) As the chief constituent of sandstones and quartzites. (5) As a secondary mineral in various rocks. (6) As petrifications and pseudomorphs after various minerals. (7) As the chief constituent of river and beach sands.

Uses:—Quartz in the form of rock crystal, amethyst, and smoky quartz is used for ornamental purposes; in the form of rock crystal for optical instruments; in the form of sand for glass making, and in the form of pulverized quartz for pottery and porcelain, and as an abrasive.

QUARTZITE. SiO_2 .

Locality:—Of common occurrence. In Greenlee County, near Metcalf, Clifton-Morenci district, it is quarried for converter lining.

Distinguishing Features:—Quartzites are metamorphic sandstones, with a firm siliceous bonding of quartz or chalcedony so that on fracture the grains are broken through as well as the cement.

SANDSTONE.

Locality:—Excellent quality in great abundance in many places. Common in Grand Canyon region. Quarried for rough building at Kirkland, Yavapai County, $2\frac{1}{2}$ miles northwest of Prescott, and for flagging and rubble at Douglas, in Cochise County.

Distinguishing Features:—Sandstones are consolidated sands with quartz as the predominating mineral. If feldspar is present in considerable amounts, it is called an arkose.

SCHEELITE. (Ore of Tungsten.) CaWO_4 .

Locality:—Cochise County, small quantity in quartz veins cutting granite, four miles north of Dagoon. Pinal County, Maudina mine, Old Hat district, Santa Catalina mountains. Santa Cruz County, small quantity mined as tungsten ore with wolframite, $7\frac{1}{2}$ miles north of Nogales.

Distinguishing Features:—Crystals are generally small, well developed, and pyramidal in habit. Occurs often as crystalline crusts on quartz; also in reniform, disseminated or granular masses. Dis-

tinct cleavage in four directions. Conchoidal to uneven fracture. Hardness, 4.5 to 6. Sp. Gr., 6. Greasy to adamantine lustre. White streak. Transparent to opaque. Color, white, yellow, gray, brown, green or reddish.

Blowpipe Tests.:—Fusible with difficulty at 5. Sodium phosphate bead (NaPO_4) is blue in the reducing flame; yields when treated with hydrochloric acid (HCl) and metallic tin, a deep blue precipitate. Decomposed hydrochloric acid (HCl) with the separation of a yellow residue (WO_3) which is soluble in ammonia (NH_4OH).

Occurrence.:—In veins, especially in tinstone veins, with cassiterite, fluorite, topaz, etc.

Uses.:—Scheelite is one source of tungsten.

SERPENTINE. $\text{H}_4\text{Mg}_3\text{Si}_2\text{O}$

Locality.:—Greenlee County, pure yellow, translucent, west of Morenci; dark green with magnetite at Thompson mine. Other localities.

Distinguishing Features.:—Serpentine is never found in crystals although it often occurs pseudomorphous after other crystallized minerals. It is usually compact or granular massive, but also occurs in fibrous, columnar, and lamellar forms. Hardness, 3 to 4. Sp. Gr., 2.5. Conchoidal to splintery fracture. Smooth to greasy feel. Dull resinous, greasy or waxy lustre. Takes an excellent polish. Translucent to opaque. Various shades of green in color; also yellowish, grayish, reddish, brownish, or black. Specimens are often multi-colored. White streak.

Blowpipe Tests.:—Fusible with difficulty at 6. In the closed tube gives water at a high temperature. Decomposed by hydrochloric acid (HCl).

Occurrence.:—(1) An alteration product of olivine and to a less extent of bronzite, forming the metamorphic rock serpentine from original peridotite. (2) A secondary mineral in seams and veins and on the border of serpentine rocks. Chrysotile, the fibrous variety and antigorite, the lamellar variety, occur in this way. (3) As an alteration product of diopside and olivine in crystalline limestones.

SILVER. (Native.) Ag.

Locality.:—Native silver in beautiful specimens has been found in Gila County, in a placer 12 miles north of Globe. Pinal County, at Silver King mine. Yavapai County, at McMillanville, at the Tiger mine. Found elsewhere also.

Distinguishing Features.:—The characteristic occurrence of silver is in wires, thin sheets, skeleton crystals, dendritic groups, and

masses. No cleavage but malleable and ductile. Hardness, 2.5 to 3. Sp. Gr., 10.5. Metallic lustre. Color, silver white, usually with yellow brown, gray or black tarnish colors. Thin sheets appear blue in transmitted light. Streak, metallic silvery white.

Blowpipe Tests.—Easily fusible (2) to a malleable button. Soluble in nitric acid (HNO_3). Hydrochloric acid (HCl) gives a white precipitate (AgCl) which turns violet on standing and is soluble in ammonia (NH_4OH).

Occurrence.—(1) In veins along with bismuth, cobalt minerals, and other silver minerals.

Uses.—Native silver is the source of some silver.

SLATE.

Locality.—Maricopa County, fair grade of roofing slate, bluish gray, $6\frac{1}{2}$ miles north of Phoenix, undeveloped.

Distinguishing Features.—Slates are dark colored, fine grained metamorphic rocks, derived from shales, which are consolidated clays. New rock cleavage, which has no relation to the original bedding, has been developed and is called slaty cleavage. The minerals of slate, as far as they can be recognized, are quartz, chlorite, muscovite, pyrite, and andalusite. The dark color is due to carbonaceous matter.

Uses.—Slates are used for roofing, blackboards, etc.

SMITHSONITE. (Calamine; Dry Bone.) ZnCO_3 .

Locality.—Greenlee County, in Shannon mountain, Clifton-Morenci district.

Distinguishing Features.—Crystals are small, usually rough and curved. Generally reniform, botryoidal, or stalactitic; also in crusts with a granular, fibrous, or compact structure. The cellular or porous varieties are sometimes called "dry bone." Perfect rhombohedral cleavage. Uneven to splintery fracture. Brittle. Hardness, 5. Sp. Gr., 4.4. Vitreous to pearly lustre. Translucent to opaque. Colorless, yellow, brown, gray, blue, green, or orange yellow. Streak, white.

Blowpipe Tests.—Infusible. Heated with cobalt nitrate solution on charcoal gives a green coating. In the closed tube turns yellow. Soluble in hydrochloric acid (HCl) with effervescence.

Occurrence.—As a secondary mineral formed from sphalerite. It also occurs as a metasomatic replacement of limestone, and is often pseudomorphous after calcite and dolomite.

Uses.—Smithsonite is an important ore of zinc.

SPHALERITE. (Zinc Blende; Black Jack.) ZnS .

Locality:—Cochise County, Tombstone district. Greenlee County, Clifton-Morenci district. Mohave County, occurs in Chloride district, Tennessee and Towne mines; Mineral Park district, Keystone mine; Cerbat district, Vanderbilt and Flores mines; Stockton Hill, Union Pass and Golconda district. Pima County, occurs with silver ores at Mammoth and many other mines, and with copper ores at Ridley mine. Pinal County, Globe district, Bobtail mine. Santa Cruz County, occurs at many mines. Yavapai County, common in Bradshaw Mountain district; at Crown King mine; at United Verde mine, Jerome district.

Distinguishing Features:—Crystals are common, often distorted. Also occurs in cleavable, fine and coarse grained masses; compact, foliated, fibrous, and more rarely in radiated and botryoidal. Perfect dodecahedral cleavage. Conchoidal fracture. Brittle. Resinous to adamantine lustre. Hardness, 3.5 to 4. Sp. Gr., 4.0. Color, varies greatly. When pure, it is white. May be brown, red, green, yellow, black, etc. Transparent to translucent. Streak, brown, light yellow or white.

Blowpipe Tests:—Fusible with difficulty at 5. On charcoal gives a white sublimate, which is yellow when hot. This sublimate heated intensely with cobalt nitrate solution gives a green color (cobalt zincate). Soluble in hydrochloric acid (HCl) with the separation of sulphur.

Occurrence:—(1) As a vein mineral associated with galena principally, also with chert, dolomite, etc. (2) As an accessory mineral in sedimentary rocks.

Uses:—Sphalerite is the most important ore of zinc.

STIBNITE. (Antimony Glance.) Sb_2S_3

Locality:—Mohave County, in Cerbat district, at Vanderbilt mine; Yavapai County, common in silver veins; in ores of Bradshaw mountains carries free gold.

Distinguishing Features:—Crystals often show vertical striations. Bladed and columnar. Occurs in coarse and fine grained masses. Compact. Perfect cleavage in one direction parallel to the side pinacoid. Slightly sectile. Metallic lustre. Hardness, 2. Sp. Gr., 4.5. Lead gray in color and streak. Often tarnishes black.

Blowpipe Tests:—On charcoal easily fusible at 1, giving a greenish-blue flame, dense white fumes, and a white sublimate close to the assay. In the open tube gives sulphur dioxide (SO_2) and a white non-volatile sublimate (Sb_2O_3) on the under side of the tube. In closed tube gives a dark red sublimate of antimony oxysulphide

($\text{Sb}_2\text{S}_3\text{O}$). Decomposed by nitric acid (HNO_3) with the separation of a white precipitate (HSbO_3).

Occurrence.—As a vein mineral associated with pyrite, sphalerite, galena, cinnebar, and realgar in a gangue of quartz, barite or calcite.

Uses.—Stibnite is the principal source of antimony.

STROMEYERITE. (Copper Silver Glance.) $(\text{Cu}, \text{Ag})_2\text{S}$.

Locality.—Pinal County, Silver King mine with other cupriferous and argentiferous ores.

Distinguishing Features.—Crystals like chalcocite. Usually massive and disseminated. Hardness, 2.5 to 3. Sp. Gr., 6.2. Conchoidal fracture. Metallic lustre. Dark lead gray in color and streak. Difficult to distinguish from chalcocite.

Blowpipe Tests.—Fusible at (1.5). In open tube gives odor of sulphur dioxide (SO_2). Roasted mineral with hydrochloric acid (HCl) gives azure blue flame. Nitric acid (HNO_3) solution gives white precipitate of silver chloride upon the addition of hydrochloric acid (HCl).

Occurrence.—Associated with silver and copper minerals.

Uses.—A valuable silver ore.

TENORITE, MELACONITE. (Black Oxide of Copper) Cu .

Locality.—Cochise County, occurs in mines at Bisbee and elsewhere.

Distinguishing Features.—Tenorite is found massive or earthy, commonly as a coating on copper minerals, rarely in crystalline scales. Hardness, 3 to 4. Sp. Gr., 6.0. Steel gray to black in color. Dull or earthy lustre. Opaque. The crystals are called *tenorite*, the earthy masses, *melaconite*.

Blowpipe Tests.—Infusible. Gives flame and bead tests for copper. Soluble in nitric acid (HNO_3) to a green solution.

Occurrence.—As a secondary mineral in the oxidized zone of copper mines. Not as common as cuprite.

Uses.—An ore of copper.

TETRADYMITTE. (Telluride of Bismuth.) $\text{Bi}_2\text{Te}_2\text{S}$.

Locality.—Yavapai County, small quantity in Montgomery mine; at Minnehaha and near Bradshaw City.

Distinguishing Features.—Small crystals. Usually in foliated or granular masses. Perfect basal cleavage. Hardness, 1.5 to 2. Marks paper. Sp. Gr., 7.2 to 7.9. Light lead gray color; upon fracture surface a strong metallic lustre, otherwise dull. Laminar, flexible.

Blowpipe Tests.—In the open tube gives a white sublimate of tellurium dioxide, which before the blowpipe fuses to colorless drops.

On charcoal fuses, gives white fumes, and entirely volatilizes; tinges the reducing flame bluish green; coats the charcoal at first white (TeO_2) and finally orange-yellow (Bi_2O_3). Some varieties give odor of sulphur dioxide (SO_2).

Tetradymite is of rare occurrence.

TETRAHEDRITE. (Gray Copper.) Cu_3SbS_4 .

Locality.—Pinal County, Heintzelman and Silver King mines. Santa Cruz County, Tyndall district, Alta mine, Treasure Vault mine and others. Yavapai County, in ores of Bradshaw Mountain district, also in copper-silver veins.

Distinguishing Features.—Excellent crystals often highly modified. Also occurs massive, granular, disseminated, and compact. No distinct cleavage. Conchoidal to uneven fracture. Brittle. Hardness, 3 to 4. Sp. Gr., 4.8. Metallic lustre, sometimes rather dull. Opaque. Steel gray to iron black often with brilliant tarnish colors. Sometimes covered with a fine crystalline coating of chalcopyrite or sphalerite. Streak, black, also reddish brown. The copper may be replaced by Fe, Zn, Ag or Hg and the antimony by arsenic.

Blowpipe Tests.—Easily fusible (at 1.5) giving dense white fumes and a white sublimate near the assay. The residue heated with soda in the reducing flame gives metallic copper. In the closed tube gives a dark red sublimate (Sb_2S_3). Soluble in nitric acid (HNO_3) with the separation of sulphur and a white residue (HSbO_3).

Occurrence.—(1) As a vein mineral, often associated with chalcopyrite. (2) In foliobands of schists, FAHLERZ being the German name for tetrahedrite.

Uses.—Tetrahedrite is an ore of copper and is known to miners as "gray copper." Argentiferous tetrahedrite is an ore of silver.

THENARDITE. (Na_2SO_4).

Locality.—Yavapai County, Verde Valley, 3 miles southwest of Old Camp Verde, occurs in large beds with rock salt, glauberite, and mirabilite.

Distinguishing Features.—Most commonly in crystalline aggregates and crystalline crusts. Cleavage in one direction. Uneven fracture. Hardness, 2.5. Sp. Gr., 2.68. Colorless to brown. Transparent. When exposed to the air it becomes covered with a white crust.

Blowpipe Tests.—Easily soluble in water. Intense yellow sodium flame.

Occurrence.—Usually found in salt or borax lakes.

TURQUOISE. $\text{Al}_2(\text{OH})_2\text{PO}_4\text{H}_2\text{O}$.

Locality.—Cochise County, near Gleeson; has been mined at Turquoise mountains. Maricopa County, occurs 12 miles east of Morristown. Mohave County, mines worked near Mineral Park, yield considerable quantities of gem material.

Distinguishing Features.—Apparently amorphous. Never crystallized, generally in seams and incrustations. No cleavage. Conchoidal fracture. Brittle. Hardness, 6. Sp. Gr., 2.7. Generally opaque. Slightly waxy lustre. Various shades of blue or green in color. White or slightly greenish streak.

Blowpipe Tests.—Infusible, but turns dark when heated and gives a green flame which is made blue by hydrochloric acid (HCl). In the closed tube at a high temperature it gives water and turns dark. Soluble in hydrochloric acid (HCl) after gentle ignition.

Occurrence.—In seams of volcanic rocks as trachytes and rhyolites.

Uses.—Turquoise is used extensively as a gem. Blue stones are more valuable than green ones.

VANADINITE. $(\text{Pb}_2\text{Cl}(\text{VO}_4)_2$.

Locality.—Occurs at numerous places associated with lead ore. Cochise County, near Fairbanks. Gila County, Globe district, at Lockwood claim; Clark & Stewart claims near Old Dominion mine. Pima County, Old Yuma mine, 14 miles northwest of Tucson. Pinal County, Mammoth mine at Schultz; Royal Dane claim, 7 miles southwest of Oracle; Black Prince mine, Pioneer district, and at Kelvin. Yavapai County, near Silver Belt mine, Big Bug district. Yuma County, Red Cloud mine.

Distinguishing Features.—Crystals are usually prismatic and of very common occurrence. Occurs also in compact, fibrous aggregates. Uneven to conchoidal fracture. Brittle. Hardness, 3. Sp. Gr., 6.8. Yellow, brown, or red in color. White to pale yellow streak. Translucent to opaque. Resinous lustre on fracture surface.

Blowpipe Tests.—Easily fusible at 1.5 on charcoal, giving a white sublimate and a metallic globule. In the closed tube with KH SO_4 gives a yellow mass. The sodium phosphate (NaPO_3) bead is green in reducing flame and yellow in oxidizing flame. If a little of the powdered mineral is added to a sodium phosphate bead saturated with copper oxide (CuO) and the whole heated, an intense azure blue flame is obtained. Soluble in nitric acid (HNO_3).

Occurrence.—A secondary mineral formed from galena. Vanadinite often occurs with wulfenite.

Uses.—Vanadinite is one source of the vanadium used as an alloy with steel, and of various compounds used in dyeing and in the manufacture of ink.

VOLBORTHITE. (Vanadate of Copper.)

Locality.—Occasionally met with in other copper and lead ores.

Distinguishing Features.—Volborthite is a hydrous vanadate of copper, barium and calcium. It occurs in small six-sided tables, or in globular forms. Color, olive-green to citrous-yellow.

WAD. (Manganese Ore.) MnO_2 & H_2O .

Locality.—Cochise County, occurs at Tombstone.

Distinguishing Features.—Wad occurs in compact layers or in earthy, more or less porous masses. It has never been found crystallized. Hardness, 1 to 3. Often soils the fingers. Sp. Gr., 3 to 4.5. Dark brown to black color. Brown streak. Composition varies. Is a mixture of the various manganese minerals. Dull lustre.

Blowpipe Tests.—Infusible. Gives water in the closed tube and also oxygen. Manganese bead tests. Soluble in hydrochloric acid (HCl) with the evolution of chlorine.

Occurrence.—(1) As a secondary mineral due to weathering of other manganese minerals. (2) In bog deposits often associated with limonite.

Uses.—Wad is used as an ore of manganese and in the manufacture of chlorine and paint.

WILLEMITE. (Zinc Silicate.) Zn_2SiO_4 .

Locality.—Greenlee County, on Modoc Mountain, Clifton-Morenci district.

Distinguishing Features.—Occurs in compact granular masses and in disseminated grains. Distinct basal cleavage. Conchoidal to uneven fracture. Hardness, 5 to 6. Sp. Gr., 4.1. Greasy, vitreous lustre. Transparent to opaque. Colorless, brown, yellowish, reddish, green, yellowish-green; rarely blue or black. Uncolored streak.

Blowpipe Tests.—Fusible at 5.5 with difficulty. With cobalt nitrate solution on charcoal the assay turns blue and the sublimate on the coal turns green. Willemite is distinguished from calamine by the absence of water in the closed tube. It gives a fine jelly when dissolved in hydrochloric acid (HCl).

Occurrence.—In crystalline limestone intimately mixed with franklinite and zincite.

Uses.—Willemite is an important ore of zinc.

WOLFRAMITE. Tungsten Ore.) $(\text{Fe}, \text{Mn})\text{WO}_4$.

Locality:—Cochise County, Whetstone mountains, 12 miles south of Benson. Maricopa County, Cave Creek, 30 miles north of Phoenix. Mohave County, 80 miles southeast of Kingman in Aquarius mountains, mines 17 miles east of Yucca. Pima County, in Arivaca district. Santa Cruz County, 7 miles north of Nogales. Yavapai County, Tip Top mine, Bradshaw mountains.

Distinguishing Features:—Crystals are generally large, thick tabular, or short, columnar; more rarely fibrous. Occurs also in bladed, curved lamellar, columnar, or granular masses. Perfect cleavage in one direction. Uneven fracture. Brittle. Hardness, 5 to 5.5. Sp. Gr., 7.4. Greasy, sub-metallic lustre. Color, black or dark brown. Streak, dark red brown to black. Opaque. Sometimes slightly magnetic.

Blowpipe Tests:—Fusible at 3 to a magnetic globule. The soda fusion is bluish green (Mn). Soluble in aqua regia with the separation of a yellow residue (WO_3).

Occurrence:—As a vein mineral especially in tinstone veins associated with cassiterite, scheelite, etc.

Uses:—Wolframite is the principal source of tungsten.

WULFENITE. (Molybdate of Lead.) PbMoO_4 .

Locality:—Occasionally found with other lead ores. Cochise County, nearly always present with silver ore of Tombstone in small quantity. Gila County, at Troy. Pima County, Old Yuma mine, 14 miles northwest of Tucson. Pinal County, Mammoth mine, Schultz. Yavapai County, Bradshaw mountains. Yuma County, at Castle Dome.

Distinguishing Features:—Crystals are most commonly square and thin tabular in habit. Also occurs in coarse or fine granular masses. Fairly perfect pyramidal cleavage. Conchoidal to uneven fracture. Brittle. Hardness, 3. Sp. Gr., 6.7. Resinous or adamantine lustre. Transparent to translucent. The color may be various shades of yellow, green, gray, or red. Yellowish white streak.

Blowpipe Tests:—Easily fusible at 2 on charcoal giving a metallic button. The sodium phosphate (NaPO_3) bead is green in reducing flame. Decomposed by hydrochloric acid (HCl). Gives a blue solution with sulphuric acid (H_2SO_4) and alcohol.

Occurrence:—As a secondary mineral in veins, often associated with vanadinite.

Uses:—Wulfenite and molybdenite are sources of molybdenum.

GLOSSARY

A

- Accessory Mineral.** Any mineral which may be present in a rock, but is not regarded as an essential constituent of it.
- Acicular.** In slender needle-like crystals.
- Acid Rock.** Igneous rock high in silica (SiO_2) as granites.
- Adamantine.** See lustre.
- AgCl.** Silver chloride.
- Aggregates.** Bunches or groups.
- Amalgam.** Alloy of gold and quicksilver.
- Amygdaloidal.** Referring to amygdules.
- Amygdules.** Secondary minerals filling rounded cavities in volcanic rocks.
- Amorphous.** Non-crystalline structure, like opal or glass.
- Aqua Regia.** A mixture of 3 parts concentrated hydrochloric acid and 1 part concentrated nitric acid.
- Arborescent.** Branching like a tree; dendritic.
- Argentiferous.** Containing silver.
- Auriferous.** Containing gold.

B

- Basis Rock.** Igneous rocks low in silica (less than 50% SiO_2).
- Bismuth Flux.** A mixture of 2 parts sulphur, 1 part potassium iodide (KI) and 1 part KHSO_4 .
- Black Jack.** Sphalerite.
- Botryoidal.** Resembling a bunch of grapes.

C

- Capillary.** In hair-like or thread-like crystals.
- Cellular.** Containing cells.
- Cleavage.** The capacity for being split with smooth planes in certain fixed directions, generally parallel to common crystal faces. Cleavage is perfect when the mineral splits very easily. Directions are expressed by the names of crystal forms; as cubic, parallel to the faces of a cube; octahedral, parallel to the face of an octahedron, etc.
- Columnar.** Parallel grouping of prisms or columns.

- Compact.** Being a firm aggregate of exceedingly minute particles, like clay.
- Conchoidal.** See fracture.
- Concretion.** Rounded nodules in sedimentary rocks, especially shales and sandstones.
- Contact Mineral.** Mineral formed in the contact zone.
- Contact Zone.** The zone bordering the contact of igneous and sedimentary rocks.
- Cupriferous.** Containing copper.

D

- Decrepitate.** Flies to pieces when heated.
- Dendritic.** Branching like a tree.
- Diabase.** An igneous rock.
- Dike.** A tabular mass of intrusive igneous rock.
- Diorite.** A plutonic igneous rock composed essentially of plagioclase and hornblende.
- Disintegration.** Separation of minerals by weathering.
- Disseminated.** Scattered through rock in small particles.
- Drusy.** Covered with minute crystals, giving a rough surface with many glittering faces.
- Ductile.** Capable of being drawn into wire.
- Dull.** Without lustre or shine of any kind.

E

- Earthy.** Clay-like, dull and composed of minute particles.
- Effervescence.** The bubbling caused by the action of an acid on a carbonate.
- Efflorescence.** Giving up its water of crystallization on standing.
- Enamel.** Of the nature of glass.
- Enrichment.** Concentration of values.
- Evolution of Gas.** Giving off gas under the action of acids or heat.

F

- Facet.** The polished surface of a cut stone.
- Fibrous.** Made up of fibers.
- Filiform.** Thread-like.
- Flexible.** Capable of being bent and remaining so.
- Foliated.** Made up of flat plates.

Fracture. The manner of breaking that does not produce planes of cleavage or parting; designated as *conchoidal* when rounded or curved surfaces are produced; *uneven*, when rough and irregular; *hackly*, sharp, jagged surfaces like broken metals; *splintery* when elongated splinters or needles are produced.

Fusibility. Capacity of being fused or melted in the blowpipe flame. See scale of fusibility.

G

Gangue. The non-metallic part of a vein.

Gelatinization. Formation of a jelly-like substance when the powdered mineral is boiled in acids.

Geodes. Rounded nodules with hollow centres which are lined with crystals, chiefly quartz and calcite.

Glance. A general name for metallic sulphides.

Globular. Made up of more or less complete spheres.

Gneiss. A metamorphosed (changed) rock, composed chiefly of orthoclase feldspar, quartz, and mica, having a banded structure.

Gossan. (Iron hat.) The upper oxidized portion of a vein or ore deposit.

Granite. An even grained crystalline rock composed chiefly of quartz, feldspar, mica and hornblende.

Granular. Composed of grains and small crystals.

H

Hackly. Sharp, jagged surface, like broken steel.

Hardness. Resistance to being scratched. (See scale of hardness.)

Hydration. The taking on or containing of water of crystallization.

Hydrogen Sulphide. A gaseous compound of hydrogen and sulphur (H_2S) possessing a characteristic odor of bad eggs.

I

Igneous Rocks. Rocks formed by the consolidation of molten magma.

Ignition. Heating in the blowpipe flame.

Incrustation. Occurring in a thin layer, coating some other mineral.

Insoluble. Not dissolved by acids or other solutions.

Intumescence. Bubbling of minerals when heated, due to the escape of gas.

Intrusive. Igneous rocks which have invaded other rocks are called intrusive.

Iridescence. A rainbow effect produced by interference of light in thin films.

J

Jade. A compact tough green or greenish-white ornamental stone.

Jasper. A red, yellow, or brown variety of chalcedony colored by iron oxides.

K

Kaolin. A mixture of kaolinite with other aluminous silicates forming a clay.

Kidney-ore. A variety of hematite.

L

Lamellar. Made up of plates.

Laminal. Thin layers.

Limestone. A sedimentary rock consisting of CaCO_3 .

Lustre. A term applied to the quality of light reflected from a surface. Designated as *metallic*, the lustre of a metal; *sub-metallic*, or *metalloidal*, somewhat like a metal; metallic and sub-metallic minerals are opaque and give very dark colored powder or streak. Non-metallic lustres include *vitreous*, like glass; *adamantine*, brilliant like diamond; *resinous*, the appearance of resin; *greasy* or *oily*, as if slightly oiled; pearly like mother of pearl; *silky*, like satin, due to parallel fibres.

M

Magma. The liquid mass from which igneous rocks originate by cooling and solidification.

Magmatic Segregations. Deposits of ores or minerals formed by segregation from igneous magmas.

Magnetic. Attracted by a magnet.

Malleable. Capable of being hammered out flat.

Mammillary. A surface consisting of rounded protuberances.

Marble. Any limestone capable of taking a good polish.

- Marl.** Loose, earthy deposits, of intermingled carbonate of lime with clay.
- Massive.** Without definite form or shape.
- Metallic.** See lustre.
- Metamorphic.** Changed by heat, pressure, etc., as limestone to marble, etc.
- Metasomatic Replacement.** The replacement of a rock mass or vein, in which the original structure is retained.
- Micaceous.** Composed of thin plates readily separated.

N

- Nitrates.** Salts of nitric acid (HNO_3).
- Nodular.** In rounded lumps or nodules.
- Non-crystalline.** Occurring without crystal form.

O

- Ocher.** A clay colored by iron oxide.
- Octahedron.** An isometric crystal with eight triangular faces.
- Octahedral Cleavage.** Cleavage in four directions parallel to the faces of an octahedron.
- Onyx.** A banded variety of chalcedony.
- Oolitic.** Made up of minute spheres.
- Opalescent.** Having a milk or pearly internal reflection.
- Opaque.** Not transparent.
- Oxides.** Compounds of elements with oxygen.
- Oxidized Zone.** A portion of an ore deposit (the part nearest the surface) where the minerals have been oxidized and the vein matter leached.
- Oxidizing Flame.** The extreme outer tip of a flame produced by a blowpipe or Bunsen burner. Most favorable for oxidation.

P

- Parting.** A splitting much like cleavage but occurring only at certain irregular intervals, while cleavage can be produced as readily at one point as another.
- Peacock Copper.** A name given to bornite.
- Pegmatite.** Coarse vein-like deposits occurring in plutonic igneous rocks, especially granite.
- Petrification.** The replacement of fossils by mineral substances.

- Phosphorescent.** Giving off light when gently heated, below red heat.
- Pigment.** Coloring matter.
- Pinacoid.** A form consisting of two parallel faces.
- Pitchy-lustre.** Having the lustre of pitch.
- Placers.** Stream deposits of sand and gravel.
- Plutonic Rocks.** Deep-seated igneous rocks.
- Porphyry.** An igneous rock with porphyritic texture.
- Porphyritic.** With crystals set in a fine ground mass.
- Precipitate.** To separate as a precipitate.
- Prismatic.** Elongated in one direction, but does not apply to bladed needle-like or thread-like crystals.
- Pseudomorph.** A mineral with the crystal form of another mineral.
- Pyroelectric.** Becoming electric so as to attract minute particles of tissue paper when moderately heated. A small fragment of the mineral is generally used.

Q

- Quartzite.** A metamorphic rock made up of firmly cemented quartz grains.
- Quicksilver.** Mercury.

R

- Radiated.** Having fibres, columns, or plates diverging from a central point.
- Reducing Flame.** The tip of the luminous cone of the blowpipe flame.
- Reduction.** The taking away of oxygen, or the change to a lower state of oxidation.
- Reniform.** Having a smooth, rounded, kidney-like surface.
- Replacement.** (1) Substitution of a rock or vein by mineral matter.
(2) The substitution of an element or radical by other element or radical.
- Reticulate.** Slender crystals crossing like the meshes of a net.
- Rhyolite.** A volcanic igneous rock composed essentially of quartz and orthoclase, with more or less glass.
- Rock.** An essential part of the earth's crust.
- Rock Crystal.** The clear transparent variety of quartz.

S

Saline. Having a salty taste.

Salt of Phosphorous. Sodium ammonium phosphate, a reagent used in blowpipe analysis.

Sandstone. A sedimentary rock composed of consolidated sand.

Schist. A metamorphic rock which splits into thin layers.

Secondary. Minerals formed subsequent to those of the main rock mass are said to be secondary.

Sedimentary. Laid down in water.

Sectile. Capable of being cut by a knife but not flattened under a hammer.

Separation of Sulphur. White precipitate of sulphur forms when certain sulphides are treated with acids.

Shale. A rock formed by the consolidation of fine aluminous sediments.

Soda. Sodium carbonate, a blowpipe reagent. (Na_2CO_3).

Specific Gravity. The weight of a substance compared with an equal volume of water. The approximate specific gravity may be determined by hefting in the hand.

Splendent. Having a brilliant lustre.

Stalactites. Icicle like crystalline aggregates.

Stratified Rocks. Rocks made up of layers and usually formed in water.

Streak. The color of the powder of a mineral.

Streak-plate. A piece of unglazed porcelain for testing the streak.

Striated. Marked with fine parallel lines or grooves.

Sublimate. A substance reduced to a vapor by heat and re-deposited farther from the flame.

T

Tabular. In broad flattened crystals.

Talc-schist. A talc rock that splits in thin layers.

Tarnish. A surface layer usually caused by oxidation.

Texture. The mutual relation of the minerals in a rock.

Transparent. Capable of being seen through.

Translucent. A substance is translucent when light will pass through it.

Travertine. A banded calcium carbonate deposit formed by water of springs or rivers.

Trap. A dense black igneous rock, usually either basalt or diabase.

Tufa, Calcareous. A porous deposit of calcium carbonate formed by water solution.

Tuff. A fragmental volcanic rock.

V

Variegated. Having marks or patches of different colors.

Veins. Cracks in the earth's crust which have been filled with minerals.

Vitreous. See lustre.

Volatile. Easily vaporized.

Volcanic Rocks. Igneous rocks which solidified at or near the earth's surface.

W

Weathering. Superficial alteration; decomposition of rocks by the action of heat, cold, rain, etc.

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Safety Series No. 13

University of Arizona Bulletin

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J. T. MORE, Secretary,
SOUTHWESTERN MINE SAFETY ASSOCIATION,
Ray, Arizona.

Enclosed please find ^{money}_{check} order for Three Dollars (\$3.00)
for membership in the Southwestern Mine Safety Association for
the year 1916.

Address.....
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State Safety News

Safety *Efficiency*

SAFETY SERIES No. 13

NOVEMBER 28, 1916

WELCOME

The State Safety News welcomes into the ranks of publications within the State of Arizona, the Old Dominion Bulletin, the first number of which was recently published. The publication of a bulletin by a mining company is not new but this happens to be the first within the State and they have the honor of pioneering the field. We take great pleasure in quoting their foreword and wishing them all success in their effort:

FOREWORD

It is with a great deal of pleasure that the Old Dominion Copper Mining & Smelting Company publishes this, the first number of the "Old Dominion Bulletin."

While we feel we are exceptionally fortunate in the loyalty and co-operation given us at all times by our employees, we believe that any additional link which will tend to strengthen the chain of good will and understanding between us cannot but help be beneficial, and we are hopeful this periodical will achieve this purpose.

By means of the Bulletin it is hoped to chronicle events in the every-day life of the plant that will be of interest to all at the present time, and in years to come be valuable as a record of the progress made by the company and those working for it. Misunderstandings are a fruitful source of irritation and dissatisfaction. The Bulletin will provide a direct means of communication between the management and its employees and will attempt to keep the men so informed of the company's policies as well as its aims and plans for improvements and betterment of conditions that there will be no grounds for misunderstandings. In this way, as a chronicle of events and as a means of putting the men into close touch with the company's policies and aims, it is hoped that the publication of this periodical will be justified. If by its aid the company can demonstrate its desire to give to all a square deal and to see its men satisfied and contented, and in return to be able to count on their continued co-operation, the result

will be an ever-growing bond of mutual good will and understanding which will be to the advantage of all.

**OLD DOMINION COPPER MINING
& SMELTING COMPANY.
P. G. Beckett, General Manager.**

Practice safety yourself; others will follow you.

AMBITION

Ambition, the growth of the stronger will, efficiency and success, are contagious, the same as a disease.

Jim McGuire, the receiving end of the baseball battery of Casey and McGuire, and now known as the most successful baseball scout, says that in a country town where there is one baseball find, he will eventually get three finds out of the same town. The reason, he says, is this: "All the other lads of the town hear and read of the success of the first find, and they say to themselves, 'I guess if he can do it, I can.'"

Orville Harrold, now a well known grand opera star, once drove a laundry wagon in Muncie, Indiana, and now they say there are three men in Muncie with equal promise; one of them is employed in a lounge factory.

This lounge factory boy no doubt said to himself: "If he can, I can."

This, no doubt, is the reason why so many writers come from central Indiana. Some fellow wrote a successful book, and some of his neighbors said: "If he can do it, I can."

Obviously, all who try baseball, opera singing or authorship do not succeed, but there is more ambitious effort for the exercise of will after an example of conspicuous success than before; and on the law of average, some obtain a degree of success.

And so it is, ambition, the growth and strength of will, efficiency and success, are as contagious as disease.

A man, for instance, lays out an allotment on the outskirts of a city. It is common enough practice for a promoter to build enough houses to establish a standard, and those that buy the lots equal this standard, and frequently surpass it.

This allotment promoter simply creates an environment, and it becomes the will of the purchasers to reproduce and excel.

By the unconscious exercise of their wills, people naturally become

more efficient, not only by the association and example of efficient individuals, but by the association with things efficient.

A man, for instance, who eats better food, and better prepared food, who wears better clothes, carries a better watch, lives in a better house and surrounds himself with better furniture, all better than he has been in the habit of having, is making himself a more efficient man.

He becomes efficient by induction, the same as a dead wire running at the side of a live wire takes on current from the live wire.

Men become efficient from the association with things efficient just as naturally, just as unconsciously, as we speak and write better English by reading the works of the best literary masters—we do it unconsciously, without knowing why or how.

It is a poor rule that will not reciprocate, so that inefficiency is the result of association with men and things inefficient.

Men will degenerate under dirt and disorder.

We should be as guarded with our association with pessimists and failures as we are ready to seek the efficient and the optimistic, for one is as contagious as the other.

The bodily health improves the mental health, and the mental health improves the bodily health.

The cycle is complete.

Efficiency becomes a habit. We repel the evil more easily than we repel the good in a decadent stage; for good is natural and evil is unnatural. The efficient man has no desire to do wrong, because it is all a matter of efficiency. What the old religions called the sanctified man, is in reality the totally efficient man.

Real personal prosperity or accumulating wealth or an estate is not in just conserving our earnings, it is not in skimping or being miserly in our expenditures.

It is more in increasing our earning—earning more in order to save more.

And to increase our earning we must increase our efficiency by surrounding ourselves with the best within our means and always save something, and always realizing that there is a hair line, in what we buy and use, where efficiency ends and extravagance begins.

An efficient environment makes us efficient to earn more and to save more.

And saving is important to personal efficiency, it is indispensable; for a savings account eliminates fear, it gives us courage to expand without fear of want.

Every additional dollar in the savings account gives one additional dollar's worth of backbone.

FIRST AID WORK AT OLD DOMINION

A brief summary of the growth of the Old Dominion "First Aid" work to date is of interest as emphasizing the remarkable success that the movement has had with this company, which success is largely attributable to the whole-hearted support that has been given it by employees in general.

Previous to 1914 First Aid training work had been carried on by the Medical Department and had been limited to shift bosses and foremen. In April of that year the United States Bureau of Mines Rescue Car No. 2 visited Globe for one week, training all who applied. Seventy-two Old Dominion employees took this training work, of whom 40 received the government certificate. In June of that year Mr. Orr Woodburn, formerly with the United States Bureau of Mines Rescue Car, joined the company and immediately commenced First Aid courses with the idea of increasing the interest in this work. The response on the part of the men was very gratifying, and during that winter 181 received the Old Dominion First Aid button, which is given to each candidate on his passing a stiff examination at the completion of the regular course. Thirty-two finished without receiving a button, while 172 more took a good part of the course but were unable to finish it on account of changing shifts, etc., making a total of 375 fully and partially trained. Much credit is due to the men in general who helped Mr. Woodburn get this movement started in 1914, and particularly to a few who gave the work their untiring support and help at that time and on every possible occasion since. It is support of this nature that makes all the difference between success and failure.

At the Arizona State Fair in October, 1914, the company entered two teams in the First Annual Southwestern First Aid Contest. The following men were winners of first place: G. N. Bjorge, Captain; Albert Tallon, Alfred Wilkins, Sam Boreland, William Cowling, John Walthall.

The other team, composed of Z. Tabb, Captain; D. W. Cheney, H. W. Payne, Sam Garside, Charles Askew, W. J. McCracken, won third place.

The cup, which must be won three times to become permanent property, was on display at the library for the year following until the Ray team "jumped our claim." The space and cabinet for the cup are still available at the library and it is hoped that our team will return the cup this year and later make it a permanent fixture.

On July 5, 1915, a very successful and well-attended contest between our own teams was held at the Old Dominion tennis court.

The preliminary contest was held at the library a few evenings previously. As many as ten teams entered, which was a remarkable showing under the circumstances. Seven teams entered the final contest, and the quality of the work and the dispatch with which it was done caused favorable comment throughout the district.

First Aid training work was resumed in the fall of 1915, and two teams were sent to Bisbee to represent the company at the Second Annual Southwestern First Aid Contest. One team was composed of Alfred Wilkins, Captain; Albert Tallon, Sam Boreland, Charles Askew, Wm. Cowling, C. C. Phipps. And the other of C. E. Griswold, Captain; A. S. Gifford, Harry Knight, William Johns, A. Mugford, Paul Von Kaenel.

These two teams, while unable to get into first or second place in the contest, put in some particularly hard work in preparation for the contest and made an excellent showing.

In April of this year a First Aid smoker was held at the library. This is the first entertainment that has been attempted on these lines and was a decided success. A good program, consisting of music, singing and boxing, was furnished and was enjoyed by nearly 400 employees.

First Aid contests were held during May and June of this year, and were arranged on a different plan than any of the previous contests. The plant was divided into three groups: surface, smelter and mine, with prizes consisting of vacations for the teams finishing first and second in each group. Each man in the winning team in his group received two weeks' vacation on full pay, while each man in the team winning second place in each group received one week's vacation on full pay. Three teams entered in the surface group, three in the mine and four in the smelter. Each team competed twice with the other teams in that group. This made twelve contests for the smelter and six for the other two groups. The competitions were held at the library in the evenings. One doctor and two First Aid men acted as judges, and the judges were changed around each evening. These contests attracted wide attention and much interest was displayed. Those familiar with the work were very hearty in their praise of its excellence.

The following is a list of the first and second teams in each group:

Surface—First: D. W. Cheney, John Young, James Dally, Paul Von Kaenel, S. L. Pyka, H. L. Kirby. Second: Z. Tabb, Chas. Westling, Bert Harris, C. P. Niles, I. P. Childs, W. E. Barnard.

Smelter—First: H. W. Payne, Fred Roberts, Sidney Hatch, Joe

Mason, Chas. Bigando, J. H. Granger. Second: Albert Haley, Wm. Martz, Jess Hicks, A. E. Arman, J. W. Sorrell, Elmer White.

Mine—First: W. M. Cowling, R. Trevelyn, A. Mugford, Frank Benbow, Thos. Martin, Wm. Kingdon. Second: Sam Boreland, Jake Wright, C. A. Clark, Chas. Askew, Chas. Hollow, Jack Costley.

During the first six months of this year many new men took up the work and supported the contests held during May and June. During this period fifty classes were held, with a total attendance of 1434. Twenty-one contests, with 626, and 57 contest practices, with 760 attendants. In all 129 meetings were held, with a total attendance of 2820. At the present time the company has 247 "button men," or 18 per cent of the total men employed by the company, while 635 of our present employees have attended one or more classes in First Aid, making 48 per cent of the total men fully or partially trained.

First Aid boxes and supplies with stretchers and blankets have been placed at various places around the plant on surface and underground and are inspected regularly. Signals are used in some departments to call trained First Aid men to the scene of any accident. Every effort is being made by the company to improve the First Aid service wherever possible so as to insure an injured man being treated with the greatest expediency and with the least suffering. It is the aim of the Old Dominion Copper Mining & Smelting Company, with the co-operation of its employees, to train the big majority of its men in First Aid. The support given the movement in the past has been noteworthy and generous and the company appreciates very highly the sacrifices that these men who have attended the training cars and who have entered the contests have made. It has meant that they have had to devote considerable of their time off shift to the work, but the result has been a record of success of which the men may feel justly proud. It has accomplished a great deal towards minimizing the extent of injuries. Minor and major injuries have been given prompt treatment and put in good condition for transporting the patient to the hospital, and patients are assured comfortable handling during transportation.

And above all, by this First Aid work the danger of infection has been greatly reduced, for if the doctor can receive an injury free from infection it means a great deal to him in the successful treatment of it.—OLD DOMINION BULLETIN.

There is a safe way to do everything—do it that way.

POISON FROM TEETH.

Many men suffer from stomach trouble, headache and other ailments, before they learn that a bad tooth is causing all the trouble. They may ruin their health, run up a big doctor bill and then find out a small sum spent on their teeth would have saved the suffering and saved the money.

It pays to be careful about the teeth. They are a very valuable part of you. Brush them carefully before going to bed, and upon rising in the morning. Better to spend a few minutes this way than to suffer for years after while.

Decayed teeth should be filled without delay. They catch food, which decays and forms acids and poisons. These destroy the other teeth and cause sickness.

If a tooth is filled as soon as the hole is found, the filling will be small and the tooth will be saved. When the decay is bad, the tooth will have to be removed and a false tooth or crown put in. This will be painful and expensive.

*The man who is more interested in his "rights"
than in those of his neighbor, has a hard time
keeping on peaceful terms with the world.*

FUSE

The Coast Manufacture and Supply Co., which manufactures much of the fuse used at Butte, gives the following suggestions as to the proper handling of fuse in blasting:

1. Cut fuse squarely, not slantingly, at the end that goes into the cap. A pointed end is liable to get turned over in warm weather when the fuse is pushed into the cap, resulting in a miss fire. Or in cold weather it is not particularly safe to jab a hard pointed piece of fuse into a cap.

2. While axle grease and crude oil may have some water-proofing qualities if applied to the outside of a fuse, when capped, to make a so-called water-proof joint, grease and oil are solvents of the varnish on the fuse and consequently may destroy the powder train with as great rapidity as the water which the miner is trying to exclude.

3. Don't use fuse that has been hammered or injured by falling rock, as such injury increases the burning rate; there have been instances when a fuse hammered in this matter burned almost instantaneously.

4. Don't hesitate to cut an inch of the fuse from the end, as this will prevent the damp ends from getting in the cap.—(MIN. & SCI. PRESS.)

It is everybody's business to be careful, yet it must be some-particular-body's business to see that everybody is careful. "Spirit of Caution."

WHAT IS SAFETY FIRST?

Safety First is an effort to save human life, the most valuable thing in the world, which when it goes can never be brought back.

It is trying to prevent the making of widows and orphans and poverty and misery. It is trying to save men from losing eyes, arms, and legs and making them helpless cripples for life.

The company is doing its share in this safety work. WORKMEN, are you doing yours: If an accident happens, you are the one that suffers. Stop then taking chances, avoid danger and do your work carefully. A good workman is a careful workman.—ARIZONA COPPER CO. BULLETIN.

"The best time to be careful is before you get hurt."

MINE RESCUE BREATHING APPARATUS

The manufacturers of the "Fleuss" and "Proto" breathing appliances answer the following questions for the readers of the State Safety News.

1. "Explain the general principles upon which mine rescue breathing appliances operate?"

Answer: The principle of the apparatus is that the wearer breathes the same air over and over again, the carbonic acid gas being absorbed from it after each expiration, and at the same time the requisite amount of oxygen is restored to it, thus rendering it pure and fit to be again inhaled into the lungs.

The first practicable self-contained breathing apparatus was invented by Henry A. Fleuss, about 35 years ago, and the Fleuss principle is in universal use to this day. We manufactured the apparatus then and we still make it in its greatly improved form, as you will note from the enclosed circular on "Diving Without Air Pumps or Tubes"—that we introduced the first apparatus on this principle and still use same in our self-contained diving apparatus. This form

which is still used by the German and other foreign types, we discarded some years ago in favor of a safer, better and more simple system.

2. "Which do you consider better—the helmet or the mouth breathing type of apparatus? Give your reasons."

Answer: We recommend the mouth breathing type of apparatus.

1st—Safety on account of greater simplicity and less chance of leak.

2nd—Less fatigue—more comfortable.

3rd—Gives freer movement of head.

4th—Much cooler.

5th—Wider vision.

3. "How would you determine which of two different kinds of rescue apparatus is the better?"

Answer: I would first consider from a safety point of view. Take our experience of 35 years. We found the injector type of apparatus perfectly safe in connection with our diving apparatus—we could make all parts equally strong, and the danger from an accidental leak, and the inconvenience and discomfort of carrying the apparatus on the back need not be considered (the weight not making any difference). When used on land it became necessary to reduce the weight. This made the apparatus dangerous, as the injector causes a suction through the generator. The generator cooler and connections had to be made as light as possible, and being carried on the back, liable at any time to be injured, one can readily see that if the wearer were in a poisonous atmosphere, and a leak should occur, the injector would suck the bad air in and would eventually prove fatal to the wearer.

As already stated we discarded this type some years ago in favor of our "Fleuss" or "Proto."

You will see from an examination of our "Fleuss" or "Proto" that we have positive pressure from the inside out, and should a leak occur in any part of the apparatus it could only result in the loss of a little oxygen.

If you have any doubt about this suction principle, punch a pin hole in your tin cartridge, have some one hold a match to it and see how quickly you can smell it.

The "Fleuss" or "Proto" is absolutely reliable under all conditions of use; is the lightest, most comfortable, strongest, simplest, fewer joints and connections, and the most economical.

You must consider the use. You are training men for an emergency, where the slightest defect in the apparatus may cause the loss of their life and prevent the saving of others. You must not form your opinion of an apparatus too quickly.

I have already called your attention to our recommendations of the mouthpiece. You will find that all of the best authorities are now agreeing with us. As an illustration: Take any twenty new men who have never worn any kind of an apparatus, on the start, in smoke chamber practice, where, if a leak occurs, the man comes out and fixes it, the majority will decide in favor of the helmet. Take the same number of men who have had some experience and have actually worn the apparatus in rescue work, you will find they are, as a rule, unanimous for the "Fleuss" or "Proto."

If I were not sure about any particular point I would ask for an explanation. I would consider the cost of training with the apparatus, as the best results are obtained from well trained men. On recent equipment of Car No. 8 for the U. S. Bureau of Mines, this was most clearly shown. The estimated cost of equipment was about \$2500.00; the number of hours of training the first year, 8000 hours.

The injector type of apparatus requires a cartridge which makes an average cost per hour for cartridge alone 75 cents.

8000 hours @ 75c.....	\$6000.00
Our "Proto" or "Fleuss" requires 1½ lbs. caustic lump soda—1½ x 8000, 12,000 lbs. @ 8c.....	960.00
Total saving for 1st year.....	\$5040.00

With the above information, and a careful reading of the description in our catalog, you must see that our claim is well founded, and remember, it is based on 35 years experience. That our "Fleuss" or "Proto" is the safest, strongest, most comfortable, lightest, simplest, most easily kept in repair, and most economical apparatus on the market.

4. "How much oxygen per minute does the ordinary man require? How do you determine the amount of oxygen the apparatus is furnishing?"

Answer: From 7-10 to 1 litre per minute. At the rate of 1 litre per minute our cylinders carry enough oxygen to last four hours. When facing mine fires or working in very hot places it is important that no more be given. Two litres per minute may be used during very hard work, and this amount may be obtained at any time with the "Fleuss" or "Proto" by means of our emergency valve or by-pass. The amount of oxygen per minute is measured by means of our meter, and the reduction valve is set to give any required amount. This amount per minute can easily be tested at any time by means of the meter.

5. "How would you test a rescue apparatus before giving it to a man to wear?"

Answer: See that all valves and connections on cylinders and other parts are tight and free from leakage to avoid loss of oxygen. To locate a leak apply soap lather with a small brush—any escape of gas will be indicated by foaming.

That soda in breathing bag is in good condition—the sticks should rattle when shaken.

You will soon learn to give each man the correct proportion of oxygen per minute, and he should be taught to realize that the control of the apparatus lies entirely with him, and if apparently anything is going wrong he can easily correct it—all connections are in sight and within reach of both hands. His emergency valve will supply him at once with all the oxygen he wants. The absorbing value of the caustic soda increases as it gets warmer, and by jolting the bag he can always knock off the carbonate formed on the surface of the sticks, and, if necessary, he could soon learn to husband his oxygen and sit still for ten or twelve hours, which can be done with no other apparatus.

*You are responsible for the safety of others
as well as yourself.*

SAFETY

Safety is something very personal.

It is personal insurance!

The observing of it cannot be thrown off and on as a cloak, nor be delegated to another.

One must think about it—make it a part of unconscious effort—make it "second nature."

Hence education in safety comes first. It is the *prime* educational factor, for without it and the habits it brings, the inevitable accident may come and deprive one of the need of training.

Apathy, recklessness and prejudice are mental weeds which the safety habit will kill.

Let the Safety Idea be quickest on the trigger and shoot first.

—NATIONAL SAFETY COUNCIL.

*Many a man gets cold feet on finding himself
in hot water.*

*For a man not to skid on the road of life
requires a lot of sand.*

THE CHANCE AND THE GAIN

JAMES CALLAN, Oil Flotation Dept., Washoe Reduction Works.

To the Indian, it must appear funny that his highly civilized white brother must be restrained by law or dissuaded by safety first propaganda from endangering his own life. To be sure, the instinct of self-preservation actuates him as strongly as it does the Indian, when the danger is absolutely immediate; but grant that death or danger do not directly stare him in the face or that there is a possibility of escape and the slightest gain, the merest prospect of advantage is sufficient to induce him to take the risk. He jumps on or off a moving street car to save himself walking a block; he rides on the steps of the platform rather than wait three minutes for a safe, comfortable seat in the next car; he climbs under or between railroad cars or rushes across the track in front of the engine to gain the few minutes it would take the train to pass or he swings himself over machinery from one floor to another to save seconds in using the stairway.

No one in the world, perhaps, is wise enough to employ all his time usefully. Most of us spend hours of each day in idleness or profitless occupation. Therefore, when the greatest of all things—the preservation of life and limb—is at stake, is it not utter madness to weigh the convenience of the moment against weeks of suffering in a hospital, or to seek the gain of minutes today at the risk of losing all time.

*Taking chances fills the hospitals with men
having mangled bodies and broken limbs.*

MINOR AND "NEAR" ACCIDENTS

In the whole field of accident prevention work there is probably no source of information that may be of greater use to safety first men, and workmen in general, than the lessons that may be drawn from the observation, or study, of the causes of the minor and "near" accidents. In number, they are so many that nearly everyone has personal knowledge of some such occurrences almost daily or weekly, and yet because of the trivial consequence little or no attention is paid to them. Actually, each minor or "near" accident contains a lesson that is just as important as that which may be drawn from those that have more serious results.

Does the accident which is caused by bad working conditions, or by the lack of some mechanical safeguard, occur because the existence of the danger was absolutely unknown to anyone? In some cases,

it may, but generally it does not. Is the man who is injured because of indulgence in some bad practise, or carelessness, injured because of a single indulgence in the bad practise? In the very great majority of cases, no. Generally the bad practise will have continued until disregard for the danger caused the carelessness which resulted in the accident, or else carelessness was a general habit. Under these circumstances, it is, therefore, safe to say that in a large percentage of cases the occurrence of serious accidents might have been foreseen had the occurrence of the minor or "near" accidents been considered. Here, then, is a subject worthy of the consideration of every man who is anxious to prevent injury by accident to himself or others.

To the man on the job, the lesson will be contained in the occurrence of many instances in which he will see men taking chances and escaping injury only by the smallest of margins, and by personal experiences in the performance of his duties. The learning of the lesson requires only some powers of observation, and a realization of what the consequences might possibly have been.

To the foreman, or those immediately in authority, the information regarding the occurrence of minor or "near" accidents may come from direct observation, or indirectly from the men concerned. The general tendency will then be to pass over the occurrence as being fortunately past, and to take no steps to prevent a similar occurrence in the future. This is most decidedly the wrong course. If repairs or guards are needed, the matter cannot be attended to too soon. If the accident has happened as a result of some neglect, or carelessness, those responsible should be disciplined. The practise of overlooking infractions of minor regulations in regard to safety precautions weakens the respect paid to all such regulations so much that eventually they may be made absolutely ineffective.

Our safety first work has yet very much to accomplish, and it would be well for all those interested to start at the bottom and try to eliminate the minor accidents. Those of greater importance will then be of less frequent occurrence.—THE ANODE.

Accidents cost lives, eyes, strength and happiness—all that makes life worth living.

SAFETY FIRST VS. THE HUMORIST

One of our superintendents, who takes a very keen interest in Safety First, sent to the American Iron and Steel Institute for a pamphlet on Safety First.

One page of the pamphlet was devoted to a copy of the Universal

Danger Sign—the danger signal that should be understood and appreciated by every workman, from the unskilled foreign laborer, who can neither read nor write, to the highly trained and efficient mechanic.

This superintendent is always looking for material for his bulletin board. He figured that there might be some of his men who had not as yet seen the Universal Danger Signal, or, if they had, did not fully appreciate what it meant to the man who could not read.

He tore the page from the pamphlet and posted it on his bulletin board. When he went to take it down and forward it to some other division he found that the "humorist" had been there before him.

A badly executed pencil drawing desecrated the red disc of the "signal." The "humorist" had thrown his harpoon and departed.

What effect did this drawing have on the next man? If he laughed the "artist" has done a real injury, for the sign will not mean very much to him in the future.

The "humorist" is a dangerous man, not only to himself but to his fellow workmen. He is the man who scoffs at Safety First, who refuses to use the safeguards provided, who takes off a safeguard and fails to replace it, who makes fun of the other men when they refuse to "take a chance."

He does not realize the damage he is doing—that a few sarcastic words from him may make the other man neglect a precaution and the result of such neglect may cause a serious injury.

The next time you are tempted to make a joke at the expense of Safety First think of the effect it might have on the other fellow.

—NATIONAL SAFETY COUNCIL BULLETIN.

*Is it to be ripe old age through Safety First
or sudden death through carelessness?*

CO-OPERATION

The older employees can do much towards preventing accidents by helping the new men. It takes time for a new man to get used to working conditions, either underground or on the surface, and a little help at the start may make a lot of difference in the way he is able to do his work.

The greatest good can be accomplished only where there exists a spirit of co-operation and a willingness on the part of each individual to assist others.—THE ANODE.

*The cause of safety should appeal to every
man because it is for men.*

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University of Arizona Bulletin

IRON

BY
P. E. JOSEPH



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IRON

By P. E. JOSEPH

With the exception of aluminum, iron is the most abundant metallic element constituting the earth's crust. According to Clarke, the average of analyses of igneous rocks made in the laboratories of the United States Geological Survey showed 4.47 per cent iron. It occurs in nature native and in many compounds, giving rise to numerous minerals. Its most important ores are hematite, limonite, magnetite, and siderite. Goethite and turgite are commercially included with limonite under the name of brown hematite.

MINERALS OF IRON

METALLIC IRON

Composition:—Iron, with some nickel-chromium, cobalt and manganese.

General Description:—A tough, malleable, steel gray to iron black, heavy mineral, found in masses and embedded particles of white to gray metal, resembling manufactured iron. Many meteorites are alloys of nickel and iron, and usually when polished and etched by dilute acids, exhibit lines or bands, due to a crystalline arrangement of alloys of different proportions of iron and nickel.

Physical Characteristics:

Hardness, 4 to 5.	Sp. Gr. 7.3 to 7.8.
Lustre, metallic.	Tough and malleable.
Streak, metallic gray.	Fracture, hacky.
Color, steel gray to iron black.	Opaque.

Qualitative Tests:—Infusible. Soluble in acids. In borax or salt of phosphorus reacts only for iron.

Remarks:—Occurs in large masses on Disco Island, Greenland, and sparingly in some basalts, pyrite, nodules, etc., and locally reduced by heat from the carbonate. Also found in most meteorites, either as chief constituent or as a spongy matrix in disseminated grains.

PYRRHOTITE—MAGNETIC PYRITES—MUNDIC

Composition:—Iron sulphide, Fe_9S_4 to $\text{Fe}_{11}\text{S}_{12}$, with frequently small percentages of cobalt or nickel.

General Description:—A massive bronze metallic mineral, which is attracted by the magnet and can be scratched with a knife. Sometimes occurs in tabular hexagonal crystals.

Physical Characteristics:

Hardness, 3.5 to 4.5.	Attracted by the magnet.
Lustre, metallic.	Sp. Gr. 4.5 to 4.6.
Streak, grayish black.	Opaque.
Color, bronze, yellow to bronze-red, but subject to tarnish.	Tenacity, brittle.

Qualitative Tests:—Before blowpipe, etc., magnetic mass, evolves fumes of sulphur dioxide, but does not take fire. In closed tube, gives a little sulphur. In open tube, gives fumes of sulphur dioxide. Soluble in hydrochloric acid, with evolution of hydrogen sulphide, and residue of sulphur.

Similar Species:—Pyrrhotite resembles pyrites, bornite, and niccolite at times, but differs in being attracted by the magnet, and by its bronze color on fresh fracture.

Remarks:—Pyrrhotite is found in gabbros and schists and occasionally in the older eruptive rocks; also frequently in meteorites. It alters to pyrite, limonite and meteorite. Immense quantities are found at Strafford and Ely, Vermont; Sudbury, Canada, and Lancaster Gap, Pa. The last two deposits are nickeliferous, and are mined for this metal. Smaller deposits are common.

PYRITE. IRON PYRITES—FOOL'S GOLD

Composition:—Iron sulphide (Fe 46.7, S 53.3 per cent) often containing small amounts of copper, arsenic, nickel, cobalt and gold.

General Description:—A brass colored, metallic mineral, frequently in cubic or other isometric crystals, or in crystalline masses, which may be any shape, as botryoidal, globular, etc. Less frequently in non-crystalline masses.

Physical Characteristics:

Hardness, 6 to 6.5.	Sp. Gr., 4.9 to 5.2.
Lustre, metallic.	Opaque.
Streak, greenish black.	Tenacity, brittle.
Color, pale to full brass yellow and brown from tarnish.	Cleavage, imperfect cube.

Qualitative Tests:—On charcoal, takes fire and burns with a blue flame, giving off fumes of sulphur dioxide, and leaving a magnetic residue which, like pyrrhotite, dissolves in hydrochloric acid with evolution of hydrogen sulphide. In closed tube gives a sulphur deposit. Insoluble in hydrochloric acid, but soluble in nitric acid, with separation of sulphur.

Similar Species:—Pyrite is harder than chalcopyrite, pyrrhotite and gold. It differs from gold also, in color, streak and brittleness.

Remarks:—Pyrite is being formed today by the action of the hydrogen sulphide of thermal springs upon soluble iron salts. It has been developed in many rocks by the action of hot water on iron salts in the presence of decomposing organic matter. It may be, also, of igneous origin. Pyrite is found in rocks of all ages, associated with other metallic sulphides and with oxides of iron. In compact specimens, it is not easily altered, but granular masses readily oxidize and are decomposed, forming sulphate of iron and sulphuric acid, this acting as a vigorous agent in the decomposition of rocks. The final results are usually limonite, and sulphate of calcium, sodium, magnesium, etc. Few minerals are of such general or widespread occurrence. Innumerable large deposits are known, many of them carrying gold and copper to sufficient extent to make them of great economic importance.

Uses:—Pyrite is burned, for the manufacture of sulphuric acid, in enormous quantities.

MARCASITE—WHITE IRON PYRITES

Composition:— FeS_2 , as in pyrite.

General Description:—Marcasite differs from pyrite in crystalline form, and in little else. It occurs in ortho-rhombic forms, and in crystalline masses. The compound crystals have given rise to such names as cockscomb pyrites, spear pyrites, etc., from their resemblance to these objects. Often with radiated structure. Color on fresh fracture whiter than in pyrites.

Physical Characteristics:—

Hardness, 6 to 6.5.	Sp. Gr., 4.6 to 4.9.
Lustre, metallic.	Opaque.
Streak, nearly black.	Tenacity, brittle.
Color, pale brass yellow, darker after exposure.	Cleavage, imperfect prismatic (angle of $105^\circ 5'$)

Qualitative Tests:—Same as for pyrite.

Remarks:—Marcasite is more readily decomposed than pyrite, and is

therefore an even less desirable constituent in building materials, etc. Found in sedimentary rocks, and is often mistaken for pyrite.

The uses are the same as for pyrite.

ARSENOPYRITE—MISPICKEL

Composition:—Iron, 34.4; Arsenic, 46.0; Sulphur, 19.6 per cent. Sometimes with replacement of iron by cobalt, or arsenic by antimony in part.

General Description:—Silver white to gray mineral with metallic lustre. Usually compact or in granular masses, or in disseminated grains. Less frequently in orthorhombic crystals or columnar.

Physical Characteristics:—

Hardness, 5. 5 to 6.	Sp. Gr., 6 to 6. 2.
Lustre, metallic.	Opaque.
Streak, grayish black.	Tenacity, brittle.
Color, silver white to steel gray.	Cleavage, prismatic.

Qualitative Tests:—In closed tube yields a red sublimate; yellow when cold. On charcoal yields abundant white fumes and arsenical odor and coating, and fuses to a magnetic globule. After short treatment the residue is soluble in hydrochloric acid with evolution of hydrogen sulphide and precipitation of the yellow sulphide of arsenic. The residue may react for cobalt. Insoluble in hydrochloric acid. Soluble in nitric acid, with separation of sulphur.

Similar Species:—Massive varieties of the metallic cobalt minerals and varieties of lencopyrite resemble arsenopyrite, and are only safely distinguished by blowpipe tests. Smaltite, when massive, can be distinguished from cobaltiferous arsenopyrite only by its slight reaction with hydrochloric acid after fusion.

Remarks:—Arsenopyrite is found chiefly in crystalline rocks with other metallic sulphides and arsenides. Throughout the Rocky Mountains it is a common mineral, and frequently contains gold. The arsenopyrite found in New England usually contains cobalt.

Uses:—Arsenopyrite is the source of most of the arsenic of commerce, and occasionally contains enough gold or cobalt to pay for extraction.

LENCOPYRITE—LOLLINGITITE

Composition:— Fe_3As_4 to FeAs_2 , sometimes with cobalt, nickel, gold or sulphur.

General Description:—Massive silver white or gray metallic mineral, sometimes occurring in orthorhombic crystals, closely agreeing in angles with crystals of arsenopyrite.

Physical Characteristics:—

Hardness, 5 to 5.5.	Sp. Gr., 7 to 7.4.
Lustre, metallic.	Opaque.
Streak, grayish black.	Tenacity, brittle.
Color, silver white or gray.	Cleavage, basal.

Qualitative Tests:—Like arsenopyrite, except that sulphur reactions are less pronounced, or do not appear at all.

MAGNETITE—LODESTONE, MAGNETIC IRON ORE

Composition:—Iron oxide. Iron, 72.4 per cent; often contains titanium, magnesium.

General Description:—A black mineral with black streak and metallic lustre, strongly attracted by the magnet and occurring in all conditions from loose sand to compact coarse or fine grained masses.

Physical Characteristics:—

Hardness, 5.5 to 6.5.	Sp. Gr., 4.9 to 5.2.
Lustre, metallic to sub-metallic.	Opaque.
	Tenacity, brittle.

Color and streak, black.

Strongly affected by magnet, and sometimes itself a magnet (lodestone). Breaks parallel to octahedrons.

Qualitative Tests:—Fusible with difficulty in the reducing flame. Soluble in powder in hydrochloric but not in nitric acid.

Remarks:—Magnetite occurs chiefly in crystalline metamorphic rocks, and in eruptive rocks, partly derived from silicates containing iron. It is little altered by exposure, but organic matter reduces it to ferrous oxide, which, by oxidation, becomes hematite. (Fe_2O_3 .)

Magnetite makes up about 12 per cent of the iron ore mined in America, being obtained especially from the states of New York, Pennsylvania, New Jersey, and Michigan. Smaller amounts are present in many localities. Lodestones are obtained from Magnet Cove, Ark. Magnetite forms whole mountains in Sweden, and is practically the only iron ore mined in that country.

It is an important iron ore, highly valued for its purity.

FRANKLINITE

Composition:—A ferro-manganese oxide, sometimes containing zinc.

General Description:—A black mineral resembling magnetite. It occurs in compact masses, rounded grains and octahedral crystals. Only slightly magnetic, and generally with brown streak. The red zincite, and yellow to green willemite, are frequent associates. The crystals are modified octahedrons, rarely sharp as in magnetite.

Physical Characteristics:—

Hardness, 6 to 6.5.	Sp. Gr., 5 to 5.2.
Lustre, metallic or dull.	Opaque.
Streak, brown to black.	Tenacity, brittle.
Color, black.	Slightly magnetic at times.
Breaks parallel to octahedron.	

Qualitative Tests:—Infusible. On charcoal with soda gives white coat of zinc oxide. In beads gives manganese reaction. Slowly soluble in hydrochloric acid with evolution of some chlorine.

Similar Species:—Distinguished from magnetite and chromite by bead tests and associates.

Remarks:—The only large deposit is that in the vicinity of Franklin Furnace, New Jersey.

Uses:—The zinc is recovered as zinc white, and the residue recovered as speigeleisen, an alloy of iron and manganese used in steel manufacture. Franklinite has also been ground as a dark paint.

HEMATITE—SPECULAR IRON, RED IRON ORE

Composition:—Iron oxide. Iron, 70 per cent; often with silica, magnesia, etc., as impurities.

General Description:—Occurs in masses varying from brilliant black metallic to blackish red and brick red, with little lustre. The black is frequently crystallized, usually in thin, tabular crystals, set on edge in parallel position. Less frequently in larger highly modified forms, and finally in scale-like to micaceous masses. The red varieties vary from compact columnar, radiated and kidney shaped masses, to loose earthy red material. In *all* the varieties the streak is *red*.

Physical Characteristics:—

Hardness, 5.5 to 6.5.	Color, iron black, blackish red,
Streak, brownish-red to cherry-red.	to cherry red.
	Opaque.
Tenacity, brittle, unless micaceous.	Sometimes slightly magnetic.

Qualitative Tests:—Infusible, becomes magnetic in reducing flame.

Soluble in hot hydrochloric acid. In borax reacts for iron.

Varieties:—Specular iron, or micaceous iron.

Red hematite.

Red ochre—earthy impure hematite, usually with clay, powdery.

Clay iron stone—hard compact, red material, mixed with much clay or sand.

GOETHITE

Composition:—Hydrated oxide of iron, containing 62.9 per cent iron.

General Description:—A yellow, red or brown mineral, occurring in small distinct prismatic crystals, often flattened like scales. Also massive.

Physical Characteristics:—

Hardness, 5 to 5.5 (scratched Sp. Gr. (4 to 4.4).

by knife with difficulty). Moderately heavy.

Lustre, adamantine to dull. Opaque to translucent.

Streak, yellow-brownish yellow. Tenacity, brittle.

Color, yellow, reddish, brownish to black.

Qualitative Tests:—Fuses in thin splinters to a black magnetic slag. In closed tube yields water. Soluble in hydrochloric acid.

TURGITE. HYDROHEMATITE

Composition:—Hydrated oxide, with 66.2 per cent iron.

General Description:—Nearly black botryoidal masses and crusts resembling limonite, but with a red streak. Also bright red earthy masses.

Physical Characteristics:—

Hardness, (5.5 to 6). Not Sp. Gr. (4.29 to 4.68).

scratched by knife. Moderately heavy.

Lustre, submetallic to dull. Opaque.

Streak, brownish red. Tenacity, brittle.

Color, dark reddish-black when compact to bright red when ocherous.

Qualitative Tests:—Decrepitates violently, turns black and becomes magnetic. Yields water in closed tube, with violent decrepitation.

ILMENITE—TITANIC IRON ORE

Composition:—Iron, titanium oxide with small amounts of magnesium and manganese.

General Description:—An iron black mineral, usually massive or in thin plates or imbedded grains or as sand. Also in crystals resembling those of hematite.

Physical Characteristics:—

Hardness (5.6). Not scratched by knife.	Sp. Gr., 4.5 to 5. Opaque.
Lustre, submetallic.	Tenacity, brittle.
Streak, black to brownish-red.	Slightly magnetic.
Color, iron black.	

Qualitative Tests:—Infusible in oxidizing flame; slightly fusible in reducing flame. In salt of phosphorous gives a red bead which, on treatment in reducing flame, becomes violet; slowly soluble in hydrochloric acid and the solution boiled with tin is violet; on evaporation becomes rose red.

LIMONITE—BOG ORE—BROWN HEMATITE

Composition:—Hydrated oxide with 59.8 per cent iron. Often contains impurities, such as clay, sand, manganese, phosphorous, etc.

General Description:—Loose porous bog-ore and earthy ochre to compact varieties; often with smooth black, varnish-like surface, showing a silky lustre and fibrous structure on fracture. Sometimes stalactitic and often with smooth rounded surfaces and in pseudomorphs.

Physical Characteristics:—

Hardness (5 to 5.5) with difficulty scratched by knife.	Sp. Gr. (3.6 to 4). Moderately heavy.
Lustre, varnish-like, silky, dull.	Opaque. Tenacity, brittle.
Streak, yellowish brown.	
Color, brown, black yellow.	

Qualitative Tests:—In closed tube yields water and becomes red. Fused in thin splinters to a dark magnetic slag. Soluble in hydrochloric acid, and may leave a gelatinous residue.

SIDERITE—SPATHIC ORE

Composition:—Iron carbonate with 62.1 per cent iron. Usually contains calcium, magnesium, or manganese.

General Description:—Granular masses of gray or brown color.

Physical Characteristics:—

Hardness (3.5 to 4) scratched by knife.	Sp. Gr. (3.83 to 3.88) Moderately heavy.
Lustre, vitreous to pearly.	Opaque to translucent.
Streak, white or pale yellow.	Tenacity, brittle.
Color, gray, yellow, brown or black.	Good rhombohedral cleavage.

*Qualitative Tests:—*Decrepitates, turns black and magnetic and fuses with difficulty. Soluble in warm acids with effervescence. Slowly soluble in cold acids. May react for manganese.

CHROMITE—CHROMIC IRON

*Composition:—*Iron chromate, with alumina and magnesia sometimes replacing the iron.

*General Description:—*A massive black mineral resembling magnetite, occurring in granular or compact masses or as disseminated grains. Often intermixed with serpentine.

Physical Characteristics:—

Hardness (5.5) with difficulty scratched by knife.	Sp. Gr. (4.3 to 4.6). Moderately heavy.
Lustre, submetallic to metallic.	Opaque.
Streak, dark brown.	Tenacity, brittle.
Color, black.	May be slightly magnetic.

*Qualitative Tests:—*Infusible, sometimes slightly fused by reducing flame, and then becomes magnetic. In salt of phosphorous, in oxidizing flame, gives yellow color hot, but on cooling becomes a fine emerald green. With soda and nitre on platinum wire fuses to a mass which is chrome-yellow when cold. Insoluble in acids.

*Occurrence:—*Chromite occurs in veins and masses in serpentine.

COLUMBITE—TANTALITE

*Composition:—*Iron columbate grading into the tantalate without change in crystalline form.

*General Description:—*Black, often iridescent prismatic crystals in veins of granite. More rarely massive.

Physical Characteristics:—

Hardness (6) not scratched by knife.	Sp. Gr. (5.4 to 6.5). Heavy.
Lustre, bright submetallic.	Opaque.
Streak, dark red to black.	Tenacity, brittle.
Color, black.	Cleavage, in two directions at right angles.

Qualitative Tests:—Infusible. Fused with potassium hydroxide and boiled with tin gives deep blue solution. Insoluble in acids.

WOLFRAMITE

Composition:—Iron, manganese tungstate, containing 76.5 per cent tungsten trioxide.

General Description:—Heavy dark gray to black submetallic crystals; also in granular or columnar masses.

Physical Characteristics:—

Hardness, not scratched by Sp. Gr. (7.1 to 7.55). Very
knife. heavy.

Lustre, submetallic. Opaque.

Streak, dark brown to black. Tenacity, brittle.

Color, dark gray to black. Slightly magnetic.

Qualitative Tests:—Fuses readily to a crystalline globule, which is magnetic. In salt of phosphorous yields a reddish-yellow glass, which in reducing flame becomes green, and if this bead is pulverized and dissolved with tin, in dilute hydrochloric acid, a blue solution results. Partially soluble in hydrochloric acid, the solution becoming blue on addition of tin.

Wolframite is an important ore of tungsten.

ORIGIN OF IRON ORES

According to origin, the ores of iron may be divided as follows:

(1) Detrital deposits formed by mechanical processes of transportation and concentration. These deposits, with a few exceptions*, are of little commercial importance.

(2) Sedimentary iron ores, formed by chemical reactions in bodies of surface water. These deposits are of notable importance in the iron production of the world. The surface waters extract iron from ferro-magnesium silicates as well as from oxides or other minerals. A larger part of the dissolved iron carried by the solutions is precipitated after a short journey, but some of it is carried down by the streams into lakes and seas, in which it may be deposited on a large scale.

The most important deposit of this type in the United States are the Clinton ores. These consist of oolitic hematites in the Clinton formation of the Appalachian states. They extend from western New York through Pennsylvania, Virginia, West Virginia, Kentucky, Tennessee and northwestern Georgia into Alabama, where, near Birmingham, they attain their greatest development. They are

*The magnetic sands of Japan and along the coast of New Zealand have been extensively mined.

also found in Wisconsin and Ohio. The ores occur in beds and lenses at various horizons in the Clinton formation.

(3) Residual iron ores: All rocks exposed to the action of the atmosphere are disintegrated. The soluble constituents of them are taken into solution and are carried away, thus leaving the other less soluble constituents in a more concentrated condition. Iron, when present, either as a constituent of the rock or as a deposit usually of too low grade to be worked, is carried away by the solutions in small amounts. The great part remains in the rocks altered to the hydrated oxides, though hematite is often present. In the United States, these deposits are most abundant in the Appalachian region, mainly in Alabama, Georgia, Virginia, and Tennessee. They, however, constitute a small part of the total yearly production of iron.

(4) Deposits formed by concentration of substances, contained in the surrounding rocks, by the circulation of underground waters. The Lake Superior ore deposits are the most important in the United States, yielding four-fifths of the annual output of iron in this country. They belong to this type. These deposits, occurring in Michigan, Minnesota, and Wisconsin, consist mainly of hematite with small amounts of magnetite and, at some places, ferric hydroxide. They occur as lenses, masses and flat lying deposits in the sediments of pre-Cambrian. Some of these sediments, called "The Iron Formation," consist of siderite and iron silicates interbedded with slates and quartzites. These formations contained about 25 per cent of iron and the present ore bodies are products of concentration in the iron formations, effected by circulating waters of meteoric origin and of oxidizing character.

(5) Contact metamorphic*. The iron deposits of this type are very common, but seldom large. The ore consists chiefly of magnetite associated with more or less specularite, a little pyrite and chalcoppyrite, and iron-bearing contact silicates, such as andradite, ilvaite, forsterite, and hedenbergite. The ore bodies are usually of irregular form, unless they follow the stratification of the intruded rocks. Examples of this type are numerous, especially in western United States, but they are comparatively small. Some of the important deposits are those at Fierro, N. M.; the Heroult Mine, Shasta County, Calif.; the iron spring deposits of southern Utah, and the deposits at Cornwall, Pa.

(6) Deposits formed by magmatic differentiations: As previously stated, the average content of iron in basic rocks is about 4.46 per cent, while in some basic rocks it is contained in much greater quan-

*Contact metamorphism was taken up in more detail in the bulletin on Copper, published by the Arizona State Bureau of Mines.

tities, and it would be reasonable to expect that magmatic segregation would form an important type of iron deposits. However, this does not seem to be true. Most of the magmas contain also an excess of silica, and the iron, having a strong tendency to combine with silica, forms ferro-magnesian silicate. Thus commercial deposits of iron of this type are only found associated with syenites, syenite porphyries and veratophyres, and here the iron ore, which is magnetic, is usually later than the ferro-magnesian silicates and feldspars. The most important deposits of this type are the magnetites of the Adirondacks in northern New York. These have been worked since the early part of the last century, and they are still of considerable economic importance.

USES

According to their uses the minerals of iron may be divided into four groups:

(1) Those used in their natural state, principally for paints, limonite and hematite being the chief natural oxides ground for paint.

(2) Minerals used as iron ores: These are chiefly hematite, limonite, magnetite, and siderite. Goethite and turgite and some ilmenite are smelted with other ores. The residue from the roasting of pyrites is sometimes used as a source of iron. The greatest part of the iron ore mined in the world is converted into pig iron, which, by various processes, is converted into wrought iron, cast iron, and steel. Franklinite, after treatment for zinc, and certain manganiferous hematites and siderites, is smelted for spiegeleisen, an alloy of iron and manganese.

(3) Minerals used for extraction of acid constituents: :

(a) For sulphur—pyrite, and to a less extent, marcasite and pyrrhotite, are used for the manufacture of sulphuric acid.

(b) For arsenic—arsenopyrite is an important source of arsenic.

(c) For chromium—practically all of the chromium compounds are derived from chromite.

(d) For tungsten—tungsten and the tungstates are extracted from wolframite.

(4) Minerals used for included metals:

(a) Gold and silver: both pyrite and arsenopyrite frequently carry gold and a little silver, which may be extracted either directly by crushing and amalgamation, or by treatment of the roasted residue with chlorine or potassium cyanide solutions.

- (b) Pyrrhotite frequently carries nickel, large quantities being extracted from the pyrrhotite of Sudbury, Ontario.

PRODUCTION OF IRON IN ARIZONA

No production of iron as metal has ever been reported from this state. Some iron ores, such as the oxides and pyrite have been produced for the use as flux in smelting of other ores.



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Bulletin

Workmen's Compensations

BY
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JANUARY 16, 1916

PREFACE

The purpose of this bulletin is to furnish fundamental facts and general information on Workmen's Compensation, its underlying principles, the history of its development, some comparative details of its provisions in the various states of the United States, and the law as it is in Arizona.

The mining industry is Arizona's leading "hazardous" occupation and this fact has been kept in mind in considering the law of this state.

Rather than force upon the reader any definite conclusions or specific recommendations, it is the intention to allow the reader to arrive at his own decisions after studying the comparative data herein outlined.

J. PRESTON JONES.

University of Arizona,
Tucson.
May, 1916.

PART I.

GENERAL

"Workmen's Compensation" is a term applied to that system by which an employer pays a specific compensation to an employee injured, or to the dependents of an employee killed, while actually in his service.

The injuries compensated, the industries covered, the persons compensated, the exact compensations in case of death, the exact compensations in cases of disability, the revision of benefits, the matter of insurance, the security of payments, the settlement of disputes, and other details of this method of adjustment, are prescribed by special statutory enactments commonly designated as *"Workmen's Compensation Acts."*

Theory of Workmen's Compensation.

There are certain hazardous occupations involving their workmen in a risk which is inherent in the nature of the employment. In spite of every care exercised by the employer, and in spite of every precaution taken by the workmen, accidents are at times unavoidable.

The essential principle underlying workmen's compensation acts is that the doctrine of "fault" is unfair and unsound, and consequently should be abandoned in favor of a system which will afford each industrial workman injured some measure of relief from his suffering and inability to earn wages, and in case of his death, some compensation for the support of his dependents. In this way he becomes, as it were, a pensioner of the industry which maimed him.

It is contended that each industry should bear the burden of its personal accident losses in the same manner in which it bears the burden of accident losses to plant and to machinery.

The expense of the compensation is placed upon the employer because he is the only one who can act as the agent in adding the cost of workmen's compensation for accidents to the other costs of production. This is the most simple and the most direct way of accomplishing the result. It is assumed that the employer will in turn shift the burden of the expense—that he will reimburse himself for this expense as for his other expenses of production in the prices he receives for his product. Experience seems to justify this assumption. Though originally opposed by employers as unduly burdensome, the new policies are now accepted by them as fair and reasonable. No country that has made the change has rescinded from it.

General Development.

To fully appreciate this newly created relation between employer and employee, one must briefly review its development.

Before the passage of special legislation defining specifically the liability of the employer for accidents to or the death of workmen all adjustments between employer and employee were based on the Common Law. Under this law, an employer is liable where the accident is caused by his negligence, and under no other circumstances. It is assumed that an employer's only duty is to use reasonable care for the safety of the employee while he is performing his work. This "reasonable care for the safety of his employee" is usually considered to include (1) the providing of a reasonably safe place in which to work; (2) the furnishing of reasonably safe tools and appliances; (3) the exercise of reasonable care in the

hiring of agents and servants who are fit for the work which they are to do; and (4) the providing of suitable rules for carrying on the work. The "chance" is taken by the employee when he accepts a position. If an employee is injured and it can be *proven* that such injury was due to the failure of the employer in any of these duties, then he may recover full compensation, the amount of which is determined by a jury trial, conducted under usual legal procedure.

From this outline, it is quite self-evident that under the Common Law the "burden of proof" rests upon the employee. To secure compensation he must bring suit and prove to a jury that his employer failed in his recognized duty to exercise reasonable care for the safety of his employee—that the injury was caused by his negligence.

Those upholding the interests of the employee claim that because of the expense of law suits, because of the great fighting ability of corporations from a financial standpoint, and because of immense attorney's fees, the workman rarely ever secures any material compensation.

Those championing the cause of the employer contend that the ordinary jury is prejudiced against corporations and consequently tends to discriminate in favor of the workman.

From these two suggestions one can readily conclude that the desirability of settling injury claims under the Common Law is a mooted question.

Next, and probably as somewhat of an advance, came what is known as Employer's Liability. One effect of this legislation was to destroy the defence of "common employment." The substance of this defence was that an employee injured at the hands of a fellow-workman could not bring suit for damages against the employer. The Employer's Liability Acts placed an employee, in certain cases, in the position of a stranger, making the employer liable for negligence of his servants notwithstanding the fact that they were in common employment with the servant injured. The employer still could make a plea of contributory negligence; that is, the plea that the employee contributed to the injury through his own negligence. This step did not, however, afford a real solution for the problem of just settlements for injuries and deaths of workmen.

The industrial world felt the need of some method of adjustment where responsibility was definitely placed, where reasonable amounts of compensation were determined upon, and where an injured employee, or his family in case of his death, could be sure of receiving some relief without tedious and costly procedure through the courts.

Consequently, nations the world over struggled diligently with the question, and a sincere desire for real justice has been rewarded by

the conception of what seems to be a fair method of compensation adjustment, from both employer's and employee's standpoints.

A fundamental idea closely related to workmen's compensation was put into practice as early as 1855, when, under the influence of Bismarck, Germany's industries began to establish accident and sickness insurance funds for their workmen.

Soon the old principle of negligence was discarded and in its place a system was adopted which provides for indemnity almost entirely without regard to the fault of either the employer or the employee.

More than twenty years ago England passed her first workmen's compensation act, which provided that in hazardous occupations employers should pay damages for accidents, regardless of negligence.

Today practically every nation of the world, and notably the great industrial states of Europe, have forsaken the old policy of providing compensation to a workmen only in case of fault on the part of the employer, and in its place they have adopted the policy of requiring employers to indemnify all employees who are injured in their service, irrespective of the cause of the injury, provided, of course, that the employee did not wilfully bring the injury upon himself.

Development in the United States.

In the United States thirty-one out of our forty-eight states have adopted workmen's compensation acts. Their adoption, however, has been of more or less recent occurrence.

The movement for improved legislation in this direction began in 1902, when Maryland enacted her first compensation law. This act related only to coal mines. It was immediately declared unconstitutional.

In 1909 Montana passed a similar law. It survived for the short period of two years, and was then declared unconstitutional.

In the hope of finding a solution for the problem, the states began to adopt the method of appointing commissions to make a study of workmen's compensation in the countries of Europe. In 1909 New York and Wisconsin commissions were engaged in this work and as a result these states enacted compensation laws. In New York, the compulsory act of 1910 was declared unconstitutional on the first case tried under it (*Ives vs. Southern Buffalo Ry. Co.*) in March, 1911. The court expressed the opinion that "the act provided substantial justice but not sound law."

The enactment of solid compensation laws began in March, 1911. On the 14th day of this month both Kansas and Washington passed their acts. In 1911, nine states succeeded in enacting compensation laws; in 1912, three; in 1913, nine; in 1914, two; in 1915, eight.

The most recent enactment is that of Pennsylvania, on June 2, 1915, the law going into effect January 1, 1916.

Many of the states which do not have workmen's compensation acts have at least appointed commissions to investigate the matter and to make recommendations for legislation.

The Constitutional Obstacle.

As has been stated, progress in the enactment of compensation acts in the United States was greatly retarded by the objection that such measures were unconstitutional. The New York Court of Appeals held that requiring an employer to pay compensation where accidents or deaths were not due to his negligence was "taking his property without due process of law." This interpretation of "due process" has not, however, been the same in all of the states. In 1911, the Washington court took a directly opposite view from the New York court. Many of the states have overcome this constitutional objection by removing certain technical defences which employers had hitherto used in damage suits and then establishing compensation acts, allowing the employers to "elect" to come under this new system, which, in fact, offers them many advantages. Ohio and California amended their constitutions for the special purpose of allowing the enactment of binding compensation laws. Through favorable court decisions and the amending of constitutions, the states are now getting their systems on solid, constitutional foundations.

BRIEF DIGEST OF THE WORKMEN'S COMPENSATION ACTS OF THE VARIOUS STATES OF THE UNITED STATES.

Industries Covered.

The industries covered by the acts of the majority of the states are designated as "dangerous" or "especially dangerous," or "inherently hazardous works and occupations," etc. Many of the laws specifically designate those industries or employments which are considered dangerous and which come under the act.

In Colorado and some other states, interstate commerce business is exempted, while most of the laws exclude agricultural and domestic occupations from the list. Some states provide that a certain number of men must be employed, usually about five as a minimum. Connecticut provides for "all industries in which five or more persons are employed, in the absence of contrary election by the employer."

Illinois applies the act to all enterprises in which the law requires

protective devices, provided the employer elects. Other employers *may* elect.

New Jersey makes the law applicable to all employments *in the absence of* contrary election; while Massachusetts applies the law to all industries, *when* the employer so elects.

The Colorado, Illinois and many other acts, include public service, both state and municipal.

Texas requires the employer to subscribe to the state insurance fund, in order to come under the act.

Injuries Compensated.

In the matter of injuries compensated, there is a great deal of similarity in the laws of the various states. They are practically uniform in providing compensation for all accidental injuries causing disability or death "arising out of and in the course of the employment."

Oklahoma is the only state whose law does not provide compensation for deaths. In Louisiana, death must occur within one year after the date of the injury; in Colorado, and several other states, death must occur within two years; in Pennsylvania, within three hundred weeks. Many of the states, however, set no limit on the time within which death must take place in order that dependents may receive compensation under the act.

The period of time during which a workman must be disabled on account of his injury before he is entitled to receive compensation, varies. In Illinois, the injury must cause disability of over six working days; in Texas, at least one week; in Connecticut, more than ten days. Arizona and many other states provide for at least two weeks, while Indiana and fourteen others require that the disability must be of *more* than two weeks duration.

Practically every state denies an employee the right to receive compensation if he intentionally inflicted the injury upon himself. Other states exempt the employer if the workman's accident was due to his own wilfull misconduct. In the Indiana, as well as in several other laws, there is a provision which deprives a workman of his right to receive compensation if he wilfully refused to use safety devices or to perform certain duties required by statute.

California and many of the other acts have clauses which deny compensation to a workman who is injured as a result of intoxication. The Maine law, however, provides that if the habit was known to the employer, the injured workman is still entitled to compensation.

Persons Compensated.

The acts are practically uniform in the provision that compensation shall be made to "all employees in the industries covered." A large majority, however, exclude casual workmen.

Maryland excludes casual workmen and those receiving wages of more than \$2,000.00 a year.

Many of the laws have definite clauses including aliens. However, New Jersey provides that non-resident alien beneficiaries shall receive no benefits.

Most of the states apply the act to public employees, excluding, however, elective officials.

Compensation for Disability.

Practically all of the acts provide medical, surgical and hospital aid, the same varying in amounts and length of time. The shortest period is in Texas, whose law provides medical care for the first week of the injury. The Nevada act states that the employer shall furnish "reasonable" medical, surgical and hospital aid for not more than four months. The Nebraska period is twenty-one days; Colorado, thirty days; California, ninety days, with a provision that this period may be extended if the commission so directs; Illinois, eight weeks. Iowa, Maine, Pennsylvania, in fact, the majority of the acts state that two weeks shall be the period during which these services shall be afforded the injured workman.

With regard to the maximum cost of these services, New York places no definite limits, merely providing that the costs shall be approved by the commission. The Pennsylvania law says that the cost shall not exceed \$25, unless a major surgical operation is necessary, in which case \$75 is the maximum. In Maine, these expenses may not exceed \$30, unless by agreement or order of the commission a larger amount is provided for. Oregon has a high maximum. Its law provides "transportation, medical, surgical and hospital expenses not exceeding \$250." The West Virginia law sets an ordinary limit of \$150, but provides that in special cases the amount may be as high as \$300. The average amount is \$100.

Most of the acts divide disability into: (a) total temporary disability; (b) total permanent disability; (c) partial disability.

For certain specified injuries, such as permanent disfigurements, mutilations, the loss of an eye, an ear, a hand, etc., definite compensations are provided in most of the states.

For total disabilities, both temporary and permanent, a certain percentage of the weekly wage is paid during a specified time. In both cases the percentage is usually the same, the length of time, how-

ever, being increased in case of total permanent disability. There is usually a minimum and a maximum amount for the weekly payments, and many of the laws set a maximum of total amount to be paid.

For total disability the average percentage of weekly wages is 50%. California provides 65%. Ohio's act allows 66 2-3% of weekly wages during total temporary disability, in amount from \$5 to \$12 per week, but for not longer than six years nor more than \$3750. The New York law is very liberal, stating that 66 2-3% of wages shall be paid during the continuance of disability. The Wisconsin law provides for 65%, but adds a clause that if the injured person requires a nurse, then 100% of the wages shall be paid during the first ninety days.

The total amount limits vary. The Indiana law simply provides that the total amount shall be limited as for death benefits, and this is practically the spirit of all the acts. Probably the most liberal are those of Maryland and Nevada, whose amounts are \$5000.

In the matter of total number of weeks during which payments are made, the average for total temporary disability is about 300 to 350 weeks, and for total permanent disability about 500 weeks.

For partial disability, the average amount paid is 50% of the wage loss during an average period of 300 weeks, the average weekly payments ranging from \$4 to \$10.

Practically all acts provide that lump sum payments may be substituted after certain periods have passed. In some states this substitution must be approved by Industrial Commissions or the courts.

Compensation for Death.

Of all states having workmen's compensation acts, only one makes no compensation in case of death. The Oklahoma law does not cover fatal injuries.

If the employee leaves no dependents, the employer, under the laws of all of the states, pays the expenses of the last sickness and also the funeral expenses, ranging in total amount from \$50 in Wyoming, to \$200 in Maine, Massachusetts and several other states. The average amount is \$100. The Nebraska law provides that *in addition* to other benefits, a reasonable amount, not exceeding \$100, to cover expenses of last sickness and burial, shall be paid.

Most of the states divide dependents into two classes—those wholly dependent and those partially dependent.

Those wholly dependent ordinarily include widows or invalid widowers, and minor children.

Different bases are used for the computation of amounts of compensation to which dependents are entitled.

In some states a certain multiple of the annual earnings is paid. In California, a sum equal to three times one year's wages is paid; in Kansas, three times; in Illinois, four times, etc., with, of course, a specific maximum.

In most states, however, the amount paid is a certain percentage of the weekly wages over a certain number of weeks. For example, in Colorado, 50% of the weekly wages is paid for six years. The maximum weekly amount is \$8 and the total may not exceed \$2500, nor shall it be less than \$1000. In Connecticut, 50% of the weekly earnings for a period of 372 weeks is allowed, with a minimum of \$5 per week and a maximum of \$10.

Some states have a graduated scale of percentages, depending upon the size of the family. For instance—in Louisiana: To a widow alone, 25% of the weekly wages; 40% if there is one child; 50% if there are two or more. If there is one child alone, 25%; 40% for two, 50% for three or more. In no case may the total exceed 50% of the weekly wages. The minimum is \$3 per week and the maximum \$10 per week, for a period of not more than 300 weeks.

The number of weeks varies from 260 in Vermont to 500 in Massachusetts. The average number is 300 weeks, about six years.

The minimum and maximum total amounts are regulated by the acts. In California the range is from \$1000 to \$5000; in Illinois, from \$1650 to \$3500; in Kansas, from \$1200 to \$3600. The smallest minimum is about \$1000, while the largest maximum is \$6000, this amount being paid in Nevada in the case of a dependent widow and three or more minor children.

In most states payments to children cease when they reach the age of 18, unless they are physically incapacitated. Payments to widows or dependent widowers cease on death or remarriage. However, in Washington a widow receives a lump sum of \$240 if she remarries. In West Virginia, should a widow or an invalid widower remarry within two years of the death of the employee, they are paid 20% of the balance of ten years benefit.

In some states a distinction is made between resident and non-resident dependents. In Montana only one-half as much compensation is paid to a non-resident as to a resident dependent unless otherwise required by treaty.

Alien beneficiaries also come under separate rulings in certain states. The Kansas law prescribes that for non-resident alien beneficiaries (except in Canada) the maximum compensation is \$750, while Montana allows no compensation to non-resident alien dependents, unless required by treaty.

Partial-dependents are usually treated under separate clauses. The

California law provides that if only partial dependents survive, "such proportion of the amount paid to dependents as corresponds to the ratio between the earnings of the deceased and his contribution to their support" shall be paid to such partial dependents. That is, a partial-dependent is compensated according to the relative measure of his or her dependence. This is the rule in most of the states. Some, however, specifically prescribe a certain reduced scale.

Burden of Payment.

Practically every act provides that the burden of payment shall *all* be on the employer. West Virginia, however, places 90% on the employer and 10% on the employees.

Montana's law states that contributions may be made by employees for a hospital fund. The Nevada act provides that \$1 per month may be deducted from each employee's wages for medical expenses. Many other states have similar arrangements for hospital fees.

Oregon's law allows the employer to deduct one cent per day or part of a day from the employee's wages and the employer himself contributes according to a rate fixed by a commission for the various industries. The state gives a subsidy.

Security of Payments.

Insurance, as outlined below, is intended to secure the payments of compensations.

The general rule is that payments of compensations are preferred claims against the assets of the employer, the same as wage debts.

The Kansas law provides that lump sums awarded by the court may be secured, upon the order of the court, by "a good and sufficient bond."

The Iowa act, as well as practically all others, declares the claims exempt from creditors.

The Maryland law states that payments may not be assigned, nor are they subject to execution or attachment.

In a word, compensation payment claims are treated in general the same as wage debts.

Insurance.

The object of insurance is to afford relief to the employer and protection to the employee. The fact that insurance may be required does not lessen the employer's responsibility to the employee.

The spirit of the average act is well expressed in the substance of Pennsylvania's law, which provides that "employers must insure in the state fund, a stock or mutual company, or give proof of financial ability."

Some states specifically require a certain form of insurance. Nevada, Wyoming, and Washington compel the employer to insure in a State Fund. Oregon provides that "insurance is effected through the State Industrial Accident Fund under the supervision of the State Industrial Accident Commission."

In California municipalities are required to insure in the State Fund unless the risk is refused.

Most of the states allow the substitution of co-operative schemes by the employer and employee, pointing out, however, that the employer's responsibility is not abridged.

New Hampshire, Louisiana and New Jersey make no provision for insurance.

Settlement of Disputes.

The method of settlement of disputes used by the majority of the states is by reference to a commission, with limited rights of appeal to the courts.

In California the commission is known as the Industrial Accident Commission; in Colorado, the Industrial Commission; in Connecticut, Compensation Commissioners; in Pennsylvania, Compensation Board. The most common title is Industrial Commission.

As in Illinois, so in many of the other states, an appeal to a court is made only for a decision on points of law.

In Nevada, the matter is treated as an action in equity. In New Jersey, the settlement of disputes is handled by the Court of Common Pleas, subject to review as to questions of law by the Supreme Court. In Iowa, arbitration is the only method provided.

Revision of Benefits.

It is a general rule that benefits may be revised upon agreement of the parties. Either party may demand a review of the award within certain time limits. In Colorado this demand may be made after sixty days; in New Jersey and Minnesota after six months; in Kansas, Louisiana and other states, after one year; in Rhode Island and Maine within two years. The average is one year. In Massachusetts, however, the awards may be rescinded or amended at any time by the Industrial Accident Board for good cause. In most of the states where they have an Industrial Commission, the awards may be reviewed by the Commission at any time it deems fit.

Practically every act provides that the injured workman must submit to medical examination upon the request of the employer or at the instance of the State Commission. In New Hampshire these examinations cannot be made oftener than once a week. In Arizona

the intervals may not be less than three months. The Kansas law requires examinations at "reasonable" intervals. The Massachusetts law provides that the injured party must submit to such an examination when requested by the employer.

General.

The Canal Zone and Hawaii have compensation acts similar to those above outlined.

The United States government, on May 30, 1908, enacted a compensation law covering public employment in certain branches of its activities.

At the time of the writing of this bulletin a new general Federal Workmen's Compensation Act is before Congress.

Summary.

From the review of these features of the compensation acts of the various states, one can see that in fundamental principles and general provisions they are strikingly similar. Their differences lie chiefly in details of amounts, periods of time and routine of administration.

PART II.

ARIZONA.

Under the laws of the State of Arizona, a workman injured, or the dependents of a workman killed, in certain specified hazardous occupations may elect either to sue under the provisions of the Employers' Liability Act or to be compensated according to the provisions of the Workman's Compensation Act.

Employers' Liability Act.

This act was passed in accordance with the provisions of Section 7 of Article XVIII of the State Constitution.

It provides "that to protect the safety of employees in all hazardous occupations in mining, smelting, manufacturing, railroad, or street railway transportation, or any other industry, as provided in said Section 7 of Article XVIII of the State Constitution, any employer, whether individual, association, or corporation, shall be liable for the death or injury, caused by any accident due to a condition or conditions of such occupation, of any employee in the service of such employer in such hazardous occupation, in all cases in which such death or injury of such employee *shall not have been caused by the negligence of the employee killed or injured.*"

We can readily note the advantages this act offers to the workman in contrast to the remedies under the Common Law. Here the

workman needs only to prove that the accident was not caused by his negligence, while under the Common Law he was required to prove that the accident *was caused* by the negligence of the employer.

The *occupations* declared under this act to be hazardous include all "especially dangerous" employments, such as the construction, operation and maintenance of steam and street railroads; the use of, or the working near, explosives; building work using iron or steel frames or hoists, derricks, ladders or scaffolds twenty or more feet above ground; telephone, telegraph or other electrical work; work in mines, quarries, tunnels, subways, etc.; all work in mills, shops and factories using power machinery, etc.

The act requires the employer to adopt *rules and regulations* governing the duties and restrictions of the employment, for the sake of protecting the safety of the employees.

The employer is *liable* to the workman injured, or to the dependents of a workman killed, where the accident or the death was not caused by the employee's negligence.

The question of *contributory negligence or assumption of risk* is declared to be a question of fact and must be left to the jury. Even though the employee may have been guilty of contributory negligence this fact "shall not bar a recovery, but the damages shall be diminished by the jury in proportion to the amount of negligence attributable to such employee."

Any *contract to exempt* an employer from his liability is declared to be void.

"No action shall be maintained under this chapter unless commenced within *two years* from the day the cause of action occurred."

Workman's Compulsory Compensation Law.

This law was passed in accordance with the provision of Section 8 of Article XVIII of the State Constitution.

The first act was passed on June 8, 1912, and became effective September 1st of that year. On May 13, 1913, the act was revised, the revised law going into effect on October 1, 1913.

Digest of the Law.

Purpose. "This chapter is remedial in its purpose and shall be construed and applied so as to secure promptly and without burdensome expense to the workman the compensation herein provided and apportioned so as to provide support during the periods named for the loss of ability to earn full wages."

Public Policy. The law states that it is against *public policy* for an employer engaged in dangerous industries not to provide safety

for his workmen or to compensate injured workmen or the dependents of killed workmen.

Common Law Doctrine. "The common law doctrine of no liability without fault" is declared to be "abrogated in Arizona so far as it shall be sought to be applied to the accidents" mentioned in this act.

Industries Covered. The occupations designated as especially dangerous, within the meaning of this chapter are identical with those listed under the Employers' Liability Act, and are, in substance: "the construction, operation and maintenance of steam and street railroads; the use of, or working near, explosives; building work using iron and steel frames or hoists, derricks or ladders, or scaffolds twenty or more feet above ground; telephone, telegraph or other electrical work; work in mines, quarries, tunnels, subways, etc.; all work in mills, shops and factories using power machinery, etc."

Injuries Compensated. The act provides compensation for all personal injuries to an employee arising "out of, and in the course of" the employments specifically covered by the law, and, when death follows such injuries, then compensation for the benefit of the estate of the deceased.

Persons Compensated. The law provides that "compulsory compensation shall be paid by his employer to any workman engaged in any employment declared and determined * * * to be especially dangerous * * * if in the course of the employment of said employee personal injury thereto from any accident arising out of, and in the course of, such employment is caused in whole, or in part, or is contributed to, by a necessary risk or danger inherent in the nature thereof, or by failure of such employer * * * to exercise due care or to comply with any law affecting such employment."

The act further specifically states that "all workmen employed by an employer at manual and mechanical labor of the kinds defined" under the heading "Industries Covered," "shall be deemed and held in law to be employed and working subject to the provisions of this chapter."

In this clause we see still another advance over both the Common Law and the Employers' Liability Act in that the injured workman, or the dependents of the killed workman, do not have to prove lack of negligence on the part of the workman, it being sufficient if the accident resulted from a risk or danger "inherent in the nature of" the employment, regardless of "fault."

Election to Come Under the Act. An injured workman, desiring to come under this act, must, if able, *give notice within two weeks* after the day of the accident. This notice must state (1) name and address, (2) date and place of accident, (3) cause, (4) nature and degree of injury, (5) that compensation is claimed under this chapter. "No compensation shall be claimed or allowed so long as such notice is not given." Notice is not required if the workman is killed or "otherwise rendered incompetent to give notice, nor is notice required to be given by the representative of a deceased person."

If an employee or his personal representative so desires, he *may refuse to settle under this act*, and retain the right to sue. If, however, he elects to sue, he must pursue that course exclusively.

Employer and employee *may contract* not to come under the provisions of this chapter.

Other employments may accept and adopt the provisions of this chapter.

Waiting Period. In order to come under the benefits of this law the workman must be disabled for at least *two weeks*. The employer is not liable under the act should the employee refuse to settle under it and retain his right to sue.

Amounts of Compensation. The *measure and amount of* compensation to be made by the employer to an injured workman or his personal representative for injuries is as follows:

(1) Total Incapacity. "If the injury by accident does not result in death within *six months* from the date of the accident, but does produce or result in *total incapacity* of the workman * * * for more than *two weeks* after the accident, then the compensation to be made to such workman by his employer shall be a *semi-monthly payment*, commencing *from the date* of the accident and continuing during such total incapacity, of a sum equal to *fifty per centum* of the workman's *average semi-monthly earnings* * * *"

(2) Partial Incapacity. In case the accident only *partially incapacitates* the workman or in case the workman recovers from a total incapacity and is able to "engage at labor in some other gainful employment * * * then in each case the *amount of the semi-monthly payments* shall be *one-half of the difference* between the average earnings of the workman at the time of the accident * * * and the average amount he is earning, or is capable of earning, thereafter. * * * Such payments shall *cease* upon the workman recovering and earning, or being capable of earning * * * wages equal to the amount being paid at the time of the accident." In no case shall the *total amount* of such payments exceed four thousand dollars.

(3) For Death. When *death* results from the accident within *six months* thereafter, and the workman leaves dependents, "the employer shall pay to the personal representative of the deceased workman, for the exclusive benefit of such "dependents," a sum equal to *twenty-four hundred times one-half the daily wages* or earnings of the decedent * * * but in no event more than the sum of four thousand dollars." If the workman leaves *no dependents*, then the employer "shall pay the reasonable expenses of *medical attendance* * * * and also provide and secure his *burial* in a proper cemetery, which may be chosen by the friends of the decedent."

Burden of Payment. The law states that the "employer must make and pay compensation," thus placing upon him the entire burden of payment.

Security of Payments. A workman, or his representative, may bring action to enforce payments. Such action must be brought within one year after non-payment of any semi-monthly installment. A judgment rendered in this event may be paid in lump sum, or in installments upon the furnishing of security by the employer.

"In any action under this chapter, the court shall fix and allow * * * a reasonable *fee to the workman's attorney*, to be taxed against the employer as costs," not to exceed "twenty-five per centum of the principal of the sum recovered."

Workmen entitled to payments under this act shall have "the same *preferential claim* therefor as now is allowed by law for unpaid wages for personal services." Judgment or payments are not assignable or subject to mortgage, levy, execution, or attachment.

Settlement of Disputes. Questions arising between employer and workman, or his representative, shall be determined (1) by written agreement; (2) by arbitration, or (3) by reference and submission to the Attorney General of the State, and "in case of a refusal or failure * * * to agree upon a settlement by either of the modes above provided, then by a civil action at law."

Revision of Benefits. In view of the fact that the amount and duration of compensation payments depend upon the extent and duration of the injury, provision is made for physical examinations of the workman. The law provides that if requested by the employer, the injured workman must submit to *bodily examination* by some competent licensed medical practitioner or surgeon to ascertain and determine the nature, character, extent and effect of the injury. These examinations may not take place oftener than three months. If the

workman neglects or refuses to submit to an examination as specified, payments shall cease until he complies.

Discussion.

The discussion of this question is intended to be entirely unbiased. Its purpose is to give the views and arguments on both sides, leaving it to the reader to determine justice and needs for correction or improvement.

Employers. The employers in Arizona who are affected by this act appear to be strongly in favor of a "workman's compensation law." They recognize the fact that in these hazardous occupations accidents are bound to happen regardless of the exercise of utmost care by both employer and employee, and they are willing that workmen should be compensated. Furthermore, they realize that if an injured workman is properly taken care of, he will return to his work in a much better frame of mind and in a much better physical condition.

The employers, on the whole, seem satisfied with the general provisions of the present law. There is, however, one common complaint, namely, that the law is compulsory as regards the employer, but optional with the workman as to whether he shall elect to come under this act or retain his right to sue.

The employers feel that the act should be compulsory both ways, that there should be no question of litigation, that there should not be a chance of the compensation going to lawyers for fees rather than to the man who really needs it. For the sake of precedent, the average employer rejects the idea of being defeated in a law suit, while he is willing to settle in a reasonable way out of court.

But under Arizona's present Constitution, a law that was compulsory for both employer and employee would be unconstitutional. Article II, Section 31, of the Constitution of Arizona, states "No law shall be enacted in this state limiting the amount of damages to be recovered for causing the death or injury of any person." Furthermore, Article XVIII, Section 6, states that "the right of action to recover damages for injuries shall never be abrogated, and the amount recovered shall not be subject to any statutory limitation."

Consequently if the law were made compulsory on both sides the Constitution of the state would first have to be amended in these two respects.

Employee. The popularity of workmen's compensation acts and their decided success would seem to indicate that they are approved

of by the workmen throughout the world. Arizona's law is very similar to, and quite as liberal as that of most of the states; consequently there is little question but that its principles will meet with success here.

There are some workmen who agree with the employers that the law should be compulsory for both. They believe, that if the law is fair at all, it is fair at all times, and that there should be a rigid rule which would fit the majority of cases. They believe that there should be no question—no squabbling. They dislike the idea of the possibility of a workman being "talked into" suing for a large, and perhaps an unreasonable amount, and then either losing the suit, or losing a large part of any recovered damages to his lawyer. If there were just one method of settlement, there would be no loss of time in adjustment.

Their idea is well expressed in a bulletin entitled "Standards for Workmen's Compensation Laws," issued by the American Association for Labor Legislation, of New York City, where the following statement appears: "One of the weightiest arguments against the present system of employers' liability is that it causes vast sums to be frittered away in law suits that should be used in caring for the victims of accidents. To avoid this waste, the compensation provided by the act should be **THE EXCLUSIVE REMEDY**. If the employer has been guilty of personal negligence, even going to the point of violating a safety statute, his punishment should be through a special action prosecuted by the state itself, not through a civil suit for damages carried on at the expense and risk of the injured employee."

"This is the law in Connecticut, Illinois, Iowa, Kansas, Louisiana, Massachusetts, Michigan, Minnesota, Nebraska, New Jersey, New York, Rhode Island, and Wisconsin, except that in a few of these states if the employer fails to insure the payment of compensation the injured workman has the option of claiming compensation or of suing at law with the defenses removed."

On the other hand, there are those who cling to the Common Law doctrine, where the person aggrieved has the choice of remedies, while the aggrieved does not. They feel that the employee should retain his right to sue—that it is a grip which he has on his employer. They maintain that if an employer knew himself to be immune from law suits for accidents and deaths and subject only to a certain specific compensation, he would "take a chance" and become more negligent regarding the safety of his plant and the welfare of his employees.

There is a tendency among the workmen in the mines of Arizona to elect the Workmen's Compensation Act for minor injuries, but to sue for more serious injuries, and where they believe they have a

good chance to win in a suit. There is some feeling that the maximum amount of the compensation for death is too low.

General. An important feature of the settlement for injuries is the feeling which afterwards exists between employer and employee. The ideal system would be the one which is unquestionably fair and sufficiently co-operative to leave a "good taste in the mouths" of both parties concerned.

While Arizona's law provides compensation for partial disability, still no definite compensation is named for certain specific mutilations or disfigurements, such as the loss of an eye, an ear, a finger, etc. Most states make this provision and it is suggested by some that Arizona's act should be amended in this regard.

On the whole, however, Arizona's law would seem to compare favorable with those of most of the other states of this country. Now that the law has been in operation for a few years, the most sane method to insure wise legislation for any readjustments would be the creation of a state commission, composed of a representative of labor, a representative of the employer, and, as chairman, an economist; this commission's duty would be to thoroughly investigate the industrial situation in the state; to make a thorough study of workmen's compensation, both at home and abroad; to review with great care our present workmen's compensation law; and to present to the legislature such recommendations as are needed to provide an absolutely solid, fair, workable workmen's compensation act.

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LEAD

BY
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LEAD

By P. E. JOSEPH

Lead is a soft, bluish white metal; its freshly cut surface has a bright metallic lustre, which, upon exposure, becomes coated with a film of the oxide. Unlike other metals, it is sufficiently soft to be scratched with the thumb nail. It is fashioned into foil or wire by rolling and pressing. It is readily soluble in nitric acid, but the other acids are without special solvent effect upon the metal at ordinary temperatures. It is heavy, having a specific gravity of 11.3. Its melting point is 327 degrees C. and its atomic weight, 207.10.

It is found in nature in small quantities in many localities and is always a secondary mineral, being formed by reduction from other lead minerals through volcanic action.

LEAD ORES

GALENA

Composition: Lead sulphite (PbS), containing 86.6% lead.

Usually contains silver, stibnite, bismuth, cadmium, etc.

General Description: A soft, heavy, lead-gray mineral, with metallic lustre and easy cubic cleavage. Sometimes in crystals; rarely fine-grained or fibrous.

Physical Characteristics:

Hardness (2.5) easily scratched by knife.	Sp. Gr. (7.4 to 7.6) heavy.
Lustre, metallic.	Opaque.
Streak, lead-gray.	Tenacity, brittle.
Color, lead-gray.	Cleavage, cubic, very easy.

Qualitative Tests: On charcoal it decrepitates and fuses easily, yielding in oxidizing flame a white sulphate coating, and in reducing flame, a yellow coating and a metallic button of lead. With soda yields malleable lead and sulphur test. Soluble in excess of hot hydrochloric acid, from which, on cooling, white lead chloride separates. Soluble also in strong nitric acid, with separation of sulphur and lead sulphate.

Occurrence: Galena is a primary ore of lead. It occurs with other sulphides, especially sphalerite, pyrite and chalcopyrite, less commonly with tetrahedrite, in a gangue of quartz, fluorite, barite or calcite. Often with ores of gold and silver.

ANGLESITE

Composition: Lead sulphate.

General Description: A very brittle, colorless or white mineral of adamantine lustre, occurring massive and in concentric layers around a core of unaltered galena.

Physical Characteristics:

Hardness (3) scratched by knife.	Sp. Gr., (6.12—6.39) heavy.
Lustre, adamantine to glassy.	Transparent to opaque.
Streak, white.	Tenacity, brittle.
Color, colorless, white, gray, rarely blue or green.	

Qualitative Tests: On charcoal decrepitates and fuses easily to a glossy globule, pearly white on cooling. In reducing flame yields a metallic globule and a yellow coating. With soda yields the sulphur test. Insoluble in hydrochloric acid, but is converted into chloride. Soluble slowly in nitric acid.

Occurrence: Anglesite is a secondary mineral formed by the oxidation of galena. It changes to cerussite by the interaction with calcium carbonate solutions.

PYROMORPHITE

Composition: Lead phosphate, containing some chloride. ($\text{Pb}_3\text{Cl}(\text{PO}_4)_3$); often with some arsenic, iron or calcium.

General Description: A soft, heavy vari-colored mineral, occurring in hexagonal and tapering groups of prisms in parallel positions. Also in moss-like interlaced fibres and masses of imperfectly developed crystals. Less frequently in globular and reniform masses.

Physical Characteristics:

Hardness, 3.5 to 4.	Sp. Gr., 5.9 to 7.1 (heavy).
Lustre, resinous.	Translucent to opaque.
Streak, white to pale yellow.	Tenacity, brittle.
Color, green, gray, brown; also yellow, orange, white.	

Qualitative Tests: On charcoal fuses to a globule which on cooling does not retain its globular form but crystallizes, showing plain faces. In reducing flame yields white coat at a distance

and yellow coat nearer the assay, and a brittle globule of lead. Soluble in nitric acid, and from the solution ammonium molybdate throws down a yellow precipitate.

Remarks: Probably formed from galenite, and occurs with other lead minerals found in the oxidized zone.

MIMETITE

Composition: A complex lead arsenate, with chlorine, often with phosphorous or calcium.

General Description: A soft, heavy vari-colored mineral, occurring in hexagonal prisms or globular groups of crystals. Sometimes incrusting.

Physical Characteristics:

Hardness, 3.5.	Color, yellow brown or white.
Lustre, resinous.	Sp. Gr., 7 to 7.25 (heavy).
Streak, white.	Translucent.

Qualitative Tests: On charcoal fuses easily and is reduced to metallic lead, coating the coal with white and yellow sublimates and yielding strong arsenical odor. Phosphorous, if present, and chlorine may be detected as in pyromorphite.

CERUSSITE

Composition: A lead carbonate, carrying PbO 83.5%, CO₂ 16.5%. Often carries silver.

General Description: A heavy, soft, very brittle mineral, occurring in silky, milk white masses of interlaced fibres; granular, translucent, gray masses and compact or earthy, opaque masses of yellow, brown, etc., colors.

Physical Characteristics:

Hardness, 3 to 3.5.	Sp. Gr., 6.46 to 6.51.
Lustre, adamantine-silky.	Transparent or translucent.
Streak, white.	Tenacity, brittle.
Color, white, gray, colorless or colored by impurities.	

Qualitative Tests: On charcoal decrepitates, fuses and gives a yellow coating, and finally a metallic globule. In closed tube turns yellow, then dark, and on cooling, is yellow. Effervesces in acids, but with hydrochloric or sulphuric acid leaves a white residue.

Remarks: Cerussite is derived from galenite by the action of water containing carbon dioxide. It may also be produced from anglesite by action of a solution of calcium carbonate. Cerussite is one of the most important ores of lead.

CROCOITE

Composition: Lead chromate. PbO 68.9%; CrO 31.1%.

General Description: A relatively rare, soft, heavy mineral usually in monoclinic, prismatic crystals. but also granular and columnar.

Physical Characteristics:

Hardness, 2.5 to 3.	Sp. Gr., 5.9 to 6.1.
Lustre, adamantine.	Translucent.
Streak, orange-yellow.	Tenacity, sectile.
Cleavage, prismatic.	Color, bright hyacinth red.

Qualitative Tests: On charcoal fuses very easily, and is reduced to metallic lead with deflagration, the coal being coated with a yellow sublimate. In closed tube, decrepitates violently, becomes dark, but recovers color on cooling. With borax forms yellow glasses which are bright green, when cold. Soluble in nitric acid to a yellow solution.

VANADINITE

Composition: A lead vanadate containing chlorine, often with phosphorous or arsenic replacing vanadium. $\text{Pb}_5\text{Cl}(\text{VO}_4)_3$.

General Description: A soft, heavy, highly colored mineral, occurring in small sharp hexagonal groups and globular masses of crystals.

Physical Characteristics:

Hardness, 3.	Sp. Gr., 6.66 to 7.23.
Lustre, resinous.	Opaque to translucent.
Streak, white to pale yellow.	Tenacity, brittle.
Color, deep red, bright red. yellow or brown.	

Qualitative Tests: Fuses easily on charcoal to a black mass, yielding a yellow sublimate in the reducing flame. The residue gives a deep green bead with NaPO_3 in the reducing flame. With strong nitric acid the substance becomes deep red, then dissolves to a yellow solution.

Remarks: Is chief source of vanadium. Found in oxidized zones of lead bearing veins.

DESCLOIZITE

Composition: A lead-zinc vanadate. PbO , 55.4%; ZnO , 19.4%; V_2O_5 , 22.4%; H_2O , 2.2%.

General Description: A soft, heavy mineral, much like vanadinite.

Physical Characteristics:

Hardness, 3.5.	Sp. Gr., 5.9 to 6.2.
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Lustre, greasy.	Transparent to nearly opaque.
Streak, orange to brown.	Color, purplish red, brown or black.

Qualitative Tests: On charcoal fuses to black mass, enclosing metal. In closed tube yields water. Vanadium reactions as in vanadinite.

Remarks: Associated with vanadinite in oxidized zones of lead-bearing veins.

WULFENITE

Composition: A lead molybdate, sometimes containing calcium, chromium, or vanadium.

General Description: A soft, heavy mineral, usually in thin, square, tabular crystals, less frequently in granular masses. Resinous lustre, and yellow, orange, or bright orange-red color.

Physical Characteristics:

Hardness, 3.	Sp. Gr., 6.7 to 7.
Streak, white.	Translucent.
Cleavage, pyramidal.	Tenacity, brittle.
Color, wax yellow, bright red, brown, rarely green.	Lustre, resinous to adamantine.

Qualitative Tests: Fuses easily on charcoal, giving yellow coat and finally a metallic globule. In salt of phosphorous dissolves to a bead, which is bright green in reducing flame. In borax, yields a colorless bead in oxidizing flame, which is made brown to black in reducing flame. Partially soluble in strong hydrochloric acid to a green liquid. If the solution is greatly diluted, cooled, and tin added, it becomes deep blue and finally brown. A similar test may be obtained either by boiling in porcelain with strong hydrochloric acid and adding alcohol, or by fusing in platinum with potassium sulphate, dissolving in water and boiling with tin or zinc.

Occurrence: Wulfenite occurs both as a primary and secondary mineral, in association with other lead minerals, especially vanadinite and pyromorphite; usually found in the oxidized zone as a secondary mineral.

GEOLOGICAL OCCURRENCE AND ORIGIN

According to their origin, lead ores may be divided into two types:

A. The lead deposits in sedimentary rocks, the origin of which is independent of igneous activity.

The best examples of this type are the lead and zinc deposits of the

Mississippi Valley, the largest of which are in Missouri. The ore consists of galena and zinc blende, accompanied by their products of oxidation, such as sulphates, carbonates and silicates, in association with some pyrite, marcasite and a little chalcopyrite. Cadmium is often present in the zinc. The gangue minerals are dolomite, with some quartz, barite and some carbonaceous matter. The ores are confined to zones of local brecciation, joints, or crevices, which have been enlarged by solution, giving rise to gash veins. Less commonly they occupy fault fissures. Sometimes they occur disseminated in limestone or dolomite, following closely certain sedimentary horizons.

The rocks in which the deposits are found are the Paleozoic limestones, especially the Cambro-Ordovician. These limestones are known to contain lead and zinc in small amounts as sedimentary syngenetic deposits, and the present deposits are believed to have been concentrated from the limestone formations by acidic to alkaline artesian waters.

B. Lead deposits in genetic connection with the eruption of igneous rocks.

- (a) The silver lead veins: The most important deposits of this type are the galena-siderite veins of the Coeur d'Alene district in Idaho. The deposits occur as veins and replacements in sericitic quartzite, and shales, of pre-Cambrian age. These have been faulted, folded and intruded by monzonites enlarging downwards. Ore shoots are large and irregular. The ores consist of galena and sphalerite, and in places a little argentite rich in silver, with small amounts of chalcopyrite, pyrite and some pyrrhotite in gangue consisting largely of siderite, with some quartz. These deposits have been formed at intermediate depths by concentration from hot ascending solutions, which have probably derived their mineral content from the monzonite intrusions.
- (b) The silver-lead replacement deposits in limestone: The most important deposits of this type are those of Leadville, Colorado. The rocks consist of Paleozoic sediments resting on granite and gneiss. These formations have been intruded by numerous sheets of porphyry, which mainly lie parallel to the bedding, but in places cut diagonally across it. The intrusions and the ore deposition were followed by considerable folding and faulting. The ore, consisting of argentiferous galena, sphalerite, and pyrite, oc-

curs chiefly in the blue limestone of lower carboniferous age.

These deposits have been formed at intermediate depths by ascending solutions of doubtful origin, but charged with emanations from the igneous intrusions.

LEAD INDUSTRY IN 1915

The lead industry in 1915 made good gains in output, both in mining and smelting. The lead content of ore mined in the United States was apparently over 600,000 short tons, compared with 522,864 tons in 1914, an increase of 78,000 tons, or 15 per cent. With the higher prices prevailing, the percentage of increase in value of the 1915 output was even greater as compared with other years.

During 1915 construction was begun on one lead smelter and plans were completed for another, both to treat ore from the Coeur d'Alene district of Idaho. The Hercules Mining Company purchased the copper smelter at Northport, Wash., and began the construction of two lead furnaces. This company is affiliated with the Pennsylvania Smelting Company of Pittsburg, Pa. The Bunker Hill and Sullivan Company of the Coeur d'Alene district also completed plans for a smelter, but the site is yet in abeyance. The National refinery of the American Smelting & Refining Company, at Chicago, was dismantled, and the Balbach Smelting & Refining Company abandoned its older lead plant at Newark, N. J.

The following estimates have been compiled by C. E. Siebenthal from reports to the United States Geological Survey by all the lead refineries and soft-lead smelters in operation during the year, except two smelters in the Joplin district, for which estimates have been made. These reports cover actual production for the first 10 or 11 months of the year, with an estimate for the remainder of the year, and from them the figures of production are made up without change. The statistics of imports, exports, and lead remaining in warehouse have been taken from the records of the Bureau of Foreign and Domestic Commerce for 10 months, the figures for November and December having been estimated.

LARGEST PRODUCTION TO DATE

The production of refined lead, desilverized and soft, from domestic and foreign ores in 1915 was approximately 565,000 short tons, worth at an average New York price \$53,110,000, compared with 542,122 tons, worth \$42,285,500, in 1914, and with 462,460 tons in 1913. The figures for 1915 do not include an estimated output of 20,500

tons of antimonial lead, worth \$1,886,000, against 16,667 tons in 1914, and 16,665 tons in 1913. Of the total production, desilverized lead of domestic origin, exclusive of desilverized soft lead, is estimated at 306,682 tons, against 311,069 tons in 1914, and 250,578 tons in 1913; and desilverized lead of foreign origin at 49,318 tons, compared with 29,328 tons in 1914, and 50,582 tons in 1913. The production of soft lead, mainly from Mississippi Valley ores, is estimated at 210,000 tons, compared with 201,725 tons in 1914 and 161,300 tons in 1913. The total production of lead, desilverized and soft, from domestic ores, was thus about 516,682 tons, compared with 512,794 tons in 1914.

The final figures for the production of soft lead will show an increase of a few thousand tons over those here given, for the reason that the smelters and refiners of argentiferous lead undoubtedly treated more or less soft lead from the Mississippi Valley which is not distinguished from silver-lead ores in their preliminary estimates.

IMPORTS AND EXPORTS

The imports of lead are estimated at 9,625 short tons of lead in ore, valued at \$653,000; 50,825 tons of lead in base bullion, valued at \$3,496,000; and 400 tons of refined and old lead, valued at \$28,000—a total of 60,850 tons, valued at \$4,177,000, compared with 28,338 tons in 1914. Of the imports in 1915 about 58,000 tons came from Mexico, against 23,141 tons in 1914. These imports from Mexico are to be compared with an average of over 100,000 tons before the civil strife in that country. The remaining imports of lead came mostly from Chile.

The exports of lead of foreign origin smelted or refined in the United States again show an increase, being estimated at 43,000 tons, against 31,051 tons in 1914, and 54,301 tons in 1913. For the last two years, on the other hand, notable quantities of domestic lead have been exported to Europe, and the total for 1915 is estimated at 76,000 short tons, valued at \$6,650,000, compared to 58,722 tons, valued at \$4,501,674, in 1914.

LEAD AVAILABLE FOR CONSUMPTION

The amount of lead available for consumption during 1915 may be estimated by adding to the stock of foreign lead (domestic stocks are not known) in bonded warehouses at the beginning of the year (7,668 short tons) the imports (about 60,850 tons) the additions by liquidation (1,795 tons) and the domestic production (516,682 tons) making an apparent supply of 587,000 tons. From this are to be sub-

tracted the exports of foreign lead (about 43,000 tons) the exports of domestic lead (76,000 tons) and the stock in bonded warehouses, at the close of the year (assumed to be the same as at the close of October, 16,000 tons), leaving as available for consumption 452,000 tons, compared with 449,052 tons in 1914.

HIGH PRICES

Lead began the year at New York with a price of 3.8 cents per pound, nearly the minimum price of the year, and remained practically stationary until the middle of February. A gradual rise brought the price to 4.2 cents in April, and it remained there until the later part of May. A rapid rise next followed, and lead reached the maximum for the year at 7.56 cents on June 14. A sharp decline, followed by partial recovery and then by a more general decline, brought the price to 4.4 cents in the later part of August. After a slight recovery and another decline to 4.45 cents in September, the price gradually rose and closed the year at about 5.4 cents. The average New York price for the year was 4.7 cents a pound, compared with 3.9 cents in 1914 and 4.4 cents in 1913.

The London price of lead started at 4.1 cents a pound and rose until the later part of March, when it reached 5 cents a pound. From this point the price fell to 4.3 cents a pound, after which there was sharp ascent to 6.1 cents per pound at the middle of June. After several ups and downs the price dropped to 4.4 cents by the middle of August, and then a gradual rise carried it to 6.3 cents, and it closed the year at that figure. The London market was fairly parallel to the New York market, and except for the period of high prices in the United States during July and August, was uniformly higher than the American market.

LEAD INDUSTRY IN ARIZONA

Mohave County is the center of lead mining in Arizona, followed closely by Santa Cruz and Pima counties. It is also found scattered in many localities in Arizona, mostly as lead-silver veins.

The following table shows the production of lead in Arizona since 1894, in short tons:

Year	Quantity	Year	Quantity
1894	1480	1905	2091
1895	2053	1906	2884
1896	1165	1907	2418
1897	2184	1908	1464
1898	2224	1909	1507
1899	3377	1910	948
1900	....	1911	3428
1901	4045	1912	3891
1902	599	1913	4901
1903	1493	1914	5602
1904	1499		

PRICES

The prices of lead during 1915 were taken up above. The following table shows the highest and lowest monthly prices of lead at New York in cents per pound:

Year	January		February		March		April		May		June	
	Highest	Lowest	Highest	Lowest	Highest	Lowest	Highest	Lowest	Highest	Lowest	Highest	Lowest
1901	4.37½	4.00	4.37½	4.05	4.37½	4.05	4.37½	4.05	4.37½	4.05	4.37½	4.05
1902	4.10	4.05	4.10	4.05	4.10	4.05	4.10	4.05	4.10	4.05	4.10	4.05
1903	4.10	4.05	4.10	4.05	4.65	4.10	4.65	4.35	4.35	4.30	4.35	4.10
1904	4.50	4.45	4.50	4.40	4.60	4.50	4.60	4.50	4.50	4.25	4.35	4.20
1905	4.60	4.45	4.50	4.45	4.50	4.45	4.55	4.50	4.55	4.50	4.55	4.50
1906	5.60	5.60	5.60	5.35	5.35	5.35	5.50	5.35	5.75	5.50	5.75	5.75
1907	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	5.75
1908	3.80	3.55	3.75	3.70	4.00	3.65	4.10	3.90	4.37½	4.05	4.52½	4.32½
1909	4.22½	4.12½	4.15	3.92½	4.10	3.92½	4.25	4.10	4.35	4.20	4.35	4.35
1910	4.30	4.70	4.70	4.52½	4.60	4.35	4.40	4.35½	4.37½	4.25	4.40	4.30
1911	4.52½	4.50	4.50	4.50	4.50	4.45	4.45	4.50	4.47½	4.47½	4.45	4.45
1912	4.50	4.25	4.35	4.05	4.25	4.05	4.30	4.17½	4.20	4.15	4.50	4.20
1913	4.37½	4.35	4.40	4.35	4.40	4.35	4.50	4.35	4.50	4.35	4.40	4.35
1914	4.20	4.10	4.20	4.00	4.00	3.80	3.95	3.80	3.95	3.90	3.90	3.90

Year	July		August		September		October		November		December	
	Highest	Lowest	Highest	Lowest	Highest	Lowest	Highest	Lowest	Highest	Lowest	Highest	Lowest
1901	4.37½	4.37½	4.37½	4.37½	4.37½	4.37½	4.37½	4.37½	4.37½	4.37½	4.37½	4.00
1902	4.10	4.05	4.10	4.05	4.10	4.05	4.10	5.04	4.10	4.05	4.10	4.05
1903	4.10	4.05	4.10	4.05	4.40	4.10	4.40	4.35	4.40	4.10	4.25	4.10
1904	4.30	4.10	4.20	4.10	4.25	4.20	4.30	4.20	4.50	4.20	4.65	4.60
1905	4.60	4.50	4.85	4.60	4.90	4.85	5.30	4.85	5.40	5.15	5.90	5.25
1906	5.75	5.75	5.75	5.75	5.75	5.75	5.75	5.75	5.75	5.75	5.75	5.75
1907	5.75	5.25	5.25	5.25	5.25	4.75	4.75	4.75	4.75	4.00	4.10	3.35
1908	4.52½	4.40	4.62½	4.47½	4.60	4.52½	4.47½	4.20	4.40	4.25	4.50	4.12½
1909	4.35	4.30	4.42½	4.27½	4.40	4.32½	4.37½	4.32½	4.40	3.32½	4.70	4.37½
1910	4.45	4.35	4.40	4.40	4.40	4.40	4.40	4.40	4.50	4.40	4.50	4.50
1911	4.60	4.50	4.60	4.55	4.55	4.50	4.50	4.25	4.50	4.25	4.47½	4.47½
1912	4.75	4.60	4.85	4.47½	5.12½	4.80	5.15	5.00	5.00	4.50	4.50	4.37½
1913	3.90	3.90	3.90	3.90	3.90	3.75	3.70	3.50	3.95	3.85	3.85	3.80

METALLURGY OF LEAD

A complete discussion of the metallurgy of lead is not within the scope of this paper. The following are the principles utilized in the extraction of lead from its ores:

1. The reduction process: this is applicable to the oxides which are reduced to the metallic state by carbon, as shown by the equation $\text{PbO} + \text{C} = \text{Pb} + \text{CO}$.

2. The roast-reaction process: the sulphide ore is oxidized in a reverberatory furnace to the sulphate, as shown by the equation $\text{PbS} + 2 \text{O}_2 = \text{PbSO}_4$. The oxygen acting upon the sulphate formed in the presence of a new charge of ore reduces the sulphate to the oxide. The interaction between the oxide and a new charge of the sulphide ore results in the reduction of metallic lead as shown by the equation $2 \text{PbO} + \text{PbS} = 3 \text{Pb} + \text{SO}_2$. This process is applicable to galena free from the sulphides of the heavy metals.

3. The smelting or precipitation process: The ore is first given an oxidizing roast. The oxide is then smelted with suitable fluxes in a blast furnace, and metallic lead is produced. This lead is impure and has to be refined.

4. The lime-roasting process: This method depends upon the treatment of galena with lime or gypsum under conditions favorable for oxidation.

USES OF LEAD

The properties of lead are such as to make it one of the most useful metals. Its chief use is in the manufacture of sheet lead for various purposes; it is extensively used for lead pipes, for lining of acid containers, for paint, for lead shot, etc.

Bulletin No. 46

Economic Series No. 13

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***University of Arizona
Bulletin***



LIME ROCKS

BY
FRANK L. CULIN, JR.



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TUCSON, ARIZONA

1916-17

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University of Arizona Bulletin

ECONOMIC SERIES No. 13

JANUARY 9, 1917

LIME ROCKS.

BY FRANK L. CULIN, JR.

INTRODUCTION

Lime rocks were probably the first rocks that found a large demand among ancient peoples, and this demand has continued through all the ages down to the present time. The demand first arose because of its value as a building and ornamental stone, and as a binder for structural purposes.

A classification of lime rocks, with a general description of the sources, methods of manufacture, uses, industry, and of Arizona deposits may be of interest, and it is hoped that this bulletin will be of both interest and value.

CLASSIFICATION OF LIME ROCKS

There are two methods of classifying lime rocks: first, by structure and second, by composition. Lime rocks occur in a great variety of forms, differing in origin, color, texture, hardness, structure and composition. These types all have one common property in that they consist largely of the mineral calcite (calcium carbonate, CaCO_3) or the mineral dolomite, (a combination of calcium and magnesium carbonates, CaCO_3 , MgCO_3). No natural limestones are absolutely pure; in fact, they are as a rule, quite impure. The most common impurities are magnesium carbonate (MgCO_3), iron oxide, and carbonate, silica (SiO_2), alumina (Al_2O_3), clay, carbonaceous matter, and various other minerals. Limestones derive their wide variety of colors, as a rule, from these impurities.

While reading this classification, it should be remembered that the varieties are very apt to mingle, and that it is quite seldom that one finds any one variety in its purest form.

Structural classification:

1. Compact, dense, fine-grained limestone.
2. Crystalline limestone (non-metamorphosed).
3. Crystalline limestone (metamorphosed).
4. Oolitic and pisolitic limestone.
5. Fossiliferous limestone.

6. Shell limestone (fragmental, including corals).
7. Chalky limestone.
8. Conglomerate limestone.
9. Cherty limestone.
10. Fresh water marl.
11. Travertine, or calc sinter.
12. Stalactitic and stalagmitic limestone and onyx marble.

Chemical classification:

1. High calcium.
2. Magnesium limestone.
3. Dolomite.
4. Argillaceous limestone.
5. Arenaceous and siliceous limestone.

ORIGIN OF LIMESTONES

Limestones belong to the class of rocks known as sedimentaries. Sedimentary rocks are generally composed of materials derived from older rocks, either by mechanical or chemical decomposition. These materials are deposited (1) under water, forming marine sedimentaries, and (2) on land surfaces, forming terrestrial sedimentaries. The chief agent of transportation of these materials is water in motion; wind also is an important transporting agent. When material is carried in solid form, the deposits are said to be mechanical. When carried in solution, and precipitated without the aid of organisms, the deposits are said to be chemical. There is another type of sedimentary rock known as organic rocks. As the name implies, these rocks are formed from an accumulation of the remains of various organisms; the type also includes deposits formed from solution with the aid of organisms. Limestones may include all three types of sedimentaries.

Origin of varieties based on texture:

1. Dense, fine grained limestone: This type of limestone has been formed by deposition in quiet waters, at some distance from the shores, where only fine grained particles would be carried. In some cases, however, this type may be formed by chemical precipitation.
2. Non-metamorphosed crystalline limestone: These rocks were probably formed by a mixture of mechanical and chemical processes of deposition. The crystalline structure is due to re-crystallization through the agency of water.
3. Metamorphosed crystalline limestone: (Marble.) Marble is a granular crystalline limestone, or dolomite in which re-crystalliza-

tion has resulted from the effects of heat and pressure, usually aided by the action of water to some extent. This change is affected with practically no chemical change.

4. Oolitic limestone: This is a granular limestone, composed of small, rounded, concretionary grains, cemented together. When these grains are very small, the rock is called oolitic limestone; as they become large, the rock is called pisolitic limestone. These types are formed by the deposition of calcium carbonate about pre-existing nuclei, such as sand particles.

5. Fossiliferous limestone: This type is so named from the presence of a noticeable quantity of remains of organisms. The origin and general structure may correspond with any other types.

6. Shell limestone: This is a form of fossiliferous limestone, in which the rock is made up of shells, shell fragments and shell sand. Coquina is an example. Coral limestone is similar, except that it is made up of fragments of corals.

7. Chalky limestone: Chalk is composed of microscopic shells of foraminifera. It was probably deposited in quiet seas, far enough out to escape foreign debris.

8. Conglomerate limestone: As the name implies, this is merely a conglomeration of limestone fragments. It is a rare type.

9. Cherty limestone: This is limestone containing nodules of chert. Chert bands are deposited alternately with bands of limestone. Chert nodules are probably most commonly secondarily deposited, although they may be nodular inclusions.

10. Marl: Fresh water marl is a fine grained, loose, earthy material, largely composed of calcium carbonate. It is found in lake basins and marshes, and has been precipitated from solutions either chemically or by means of vegetable and animal organisms.

11. Travertine: Travertine, or calc sinter, often called calcareous tufa, is a massive, porous to compact limestone, deposited by waters of springs or streams along their courses.

12. Stalactitic and stalagmitic limestone and onyx marble: Stalactites are pendant columns of calcium carbonate, deposited by water dripping from the roofs of caverns in the earth. Stalagmites are the forms that rise from the floor towards the stalactites and are, of course, formed in the same manner. Onyx marble is a chemical deposit of calcium carbonate, usually considered as precipitated by deep seated hot spring waters.

Varieties based on composition:

(1) High calcium limestone: This is an exceptionally pure variety, being almost free from magnesium, as well as other impuri-

tons of antimonial lead, worth \$1,886,000, against 16,667 tons in 1914, and 16,665 tons in 1913. Of the total production, desilverized lead of domestic origin, exclusive of desilverized soft lead, is estimated at 306,682 tons, against 311,069 tons in 1914, and 250,578 tons in 1913; and desilverized lead of foreign origin at 49,318 tons, compared with 29,328 tons in 1914, and 50,582 tons in 1913. The production of soft lead, mainly from Mississippi Valley ores, is estimated at 210,000 tons, compared with 201,725 tons in 1914 and 161,300 tons in 1913. The total production of lead, desilverized and soft, from domestic ores, was thus about 516,682 tons, compared with 512,794 tons in 1914.

The final figures for the production of soft lead will show an increase of a few thousand tons over those here given, for the reason that the smelters and refiners of argentiferous lead undoubtedly treated more or less soft lead from the Mississippi Valley which is not distinguished from silver-lead ores in their preliminary estimates.

IMPORTS AND EXPORTS

The imports of lead are estimated at 9,625 short tons of lead in ore, valued at \$653,000; 50,825 tons of lead in base bullion, valued at \$3,496,000; and 400 tons of refined and old lead, valued at \$28,000—a total of 60,850 tons, valued at \$4,177,000, compared with 28,338 tons in 1914. Of the imports in 1915 about 58,000 tons came from Mexico, against 23,141 tons in 1914. These imports from Mexico are to be compared with an average of over 100,000 tons before the civil strife in that country. The remaining imports of lead came mostly from Chile.

The exports of lead of foreign origin smelted or refined in the United States again show an increase, being estimated at 43,000 tons, against 31,051 tons in 1914, and 54,301 tons in 1913. For the last two years, on the other hand, notable quantities of domestic lead have been exported to Europe, and the total for 1915 is estimated at 76,000 short tons, valued at \$6,650,000, compared to 58,722 tons, valued at \$4,501,674, in 1914.

LEAD AVAILABLE FOR CONSUMPTION

The amount of lead available for consumption during 1915 may be estimated by adding to the stock of foreign lead (domestic stocks are not known) in bonded warehouses at the beginning of the year (7,668 short tons) the imports (about 60,850 tons) the additions by liquidation (1,795 tons) and the domestic production (516,682 tons) making an apparent supply of 587,000 tons. From this are to be sub-

tracted the exports of foreign lead (about 43,000 tons) the exports of domestic lead (76,000 tons) and the stock in bonded warehouses, at the close of the year (assumed to be the same as at the close of October, 16,000 tons), leaving as available for consumption 452,000 tons, compared with 449,052 tons in 1914.

HIGH PRICES

Lead began the year at New York with a price of 3.8 cents per pound, nearly the minimum price of the year, and remained practically stationary until the middle of February. A gradual rise brought the price to 4.2 cents in April, and it remained there until the later part of May. A rapid rise next followed, and lead reached the maximum for the year at 7.56 cents on June 14. A sharp decline, followed by partial recovery and then by a more general decline, brought the price to 4.4 cents in the later part of August. After a slight recovery and another decline to 4.45 cents in September, the price gradually rose and closed the year at about 5.4 cents. The average New York price for the year was 4.7 cents a pound, compared with 3.9 cents in 1914 and 4.4 cents in 1913.

The London price of lead started at 4.1 cents a pound and rose until the later part of March, when it reached 5 cents a pound. From this point the price fell to 4.3 cents a pound, after which there was sharp ascent to 6.1 cents per pound at the middle of June. After several ups and downs the price dropped to 4.4 cents by the middle of August, and then a gradual rise carried it to 6.3 cents, and it closed the year at that figure. The London market was fairly parallel to the New York market, and except for the period of high prices in the United States during July and August, was uniformly higher than the American market.

LEAD INDUSTRY IN ARIZONA

Mohave County is the center of lead mining in Arizona, followed closely by Santa Cruz and Pima counties. It is also found scattered in many localities in Arizona, mostly as lead-silver veins.

It may be shipped in bulk, barrels or in casks. Hydrated lime is sold in sacks or in paper bags.

Lime rocks for structural purposes are either cut or blasted from the formations. The product so obtained is marketed as "dressed" or "rough" stone. The "dressed" stone is further cut into desired shapes, and often polished. "Rough" stone is sold without further treatment, unless it be to reduce the size of the product.

Lime rocks for use in the cement industry need not be pure, that is, high calcium rocks. In fact, argillaceous limestone is commonly used for this purpose. The stone is quarried, crushed to the proper size, mixed with the other ingredients of the cement, the mixture burned to a clinker, which is ground to a very fine condition, and marketed in barrels and sacks.

When used as a furnace flux, lime rocks are crushed to moderately small sizes, and mixed with the rest of the furnace charge.

THE LIME ROCK INDUSTRY

Lime rock is one of the most widely quarried rocks. The production of limestone in the United States in 1913 was valued at \$38,745,429, an increase of over \$2,000,000 over 1912. Every state in the country produced to some value, varying from \$6,328 in Arizona, to \$6,200,000 in Pennsylvania. These figures do not include the production of limestone which was burned for lime.

The total value of lime produced in 1914 was \$13,247,676 with a tonnage of 3,380,928. This is less than the 1913 production and also less than 1912. Imports of lime in 1913 were valued at \$48,438 and exports of the same year at \$212,345, both the imports and exports showing an increase in value over 1912. No figures giving the value of lime produced for the various purposes for which it is used are available.

Limestone produced for structural purposes in 1913, excluding marble, but including building, road making, railroad ballast, paving, etc., had a value of \$26,159,036.

Limestone produced for furnace flux in 1913 was valued at \$11,103,989. That sold to sugar factories, used for agricultural purposes, and for various minor purposes, was valued at \$1,932,504.

The total value of marble produced in 1913 was \$7,870,890. Vermont, Tennessee, and Georgia are the most important marble producing states.

LIME ROCKS IN ARIZONA

Lime rocks occur in many parts of Arizona. The formations in general are of two geologic ages. In north central Arizona occur

the Redwall and Kaibat formations, both of Carboniferous age. Limestone formations of the southern part of the state are both Carboniferous and Devonian. The best known of these formations are the Naco and Escubrosa at Bisbee, and the Modoc at Clifton-Morenci.

Some limestone is quarried locally in Arizona for the production of lime. In 1913 there were three plants in operation, which produced 18,292 tons of lime, valued at \$99,550. This lime is used almost entirely for building purposes.

No limestone in any important quantity was quarried in Arizona for structural purposes in 1913. Limestone used as a furnace flux was valued at \$3,628, and that sold to sugar factories at \$2,700.

There are several deposits of marble, and also onyx marble in Arizona. So far as known to the author, these deposits are not actively worked at present, although commercial production has occurred in past years. Probably the most important and best known marble is that found near Bowie. Marble of good quality also occurs in the Santa Rita and Santa Catalina mountains, near Tucson; in the Chiricahua Mountains, near Dragoon; and near Bouse in the Colorado River region. Onyx marble is found in Yavapai County, at Mayer and Cave Creek; and near Greaterville, in Pima County.

PRICES AND ECONOMIC CONSIDERATIONS

No definite price can be set on lime rocks in general, but approximate prices will be quoted for various products.

Building stone is worth from 20 to 35 cents per cubic foot for rough stone, and a minimum of about 50 cents per cubic foot for dressed stone. The price of dressed stone is, of course, very variable.

Crushed stone brings an average price of about 54 cents per ton. Furnace flux was worth about 50 cents a ton in 1913. Ground limestone, used as a fertilizer, was worth about \$1.56 per ton in 1913.

The average price of lime in 1913 was \$4.07 per ton, but it was slightly less in 1912, and also in 1914, both of these years falling below \$4. The price of Arizona lime was higher, being \$5.44 per ton in 1913.

Limestone in Arizona is a rather uncertain money-maker. Its largest use is in the production of lime; after that, its chief value is as a furnace flux, and some lime is sold to sugar factories.

There is plenty of limestone, and of good quality, not to mention the high grade marbles found, but the greatest difficulty is to secure a market.

FUTURE OF THE INDUSTRY

There is no danger that the demand for limestone will ever cease. Its application to the building industry, particularly in the making of cements and mortars, would alone be sufficient to call for a large production. The variety called marble, and onyx marble, are assured of a strong demand as ornamental and monumental stones. The demand for lime for chemical purposes will always be great, due to its cheapness.

In Arizona there will always be small local markets for lime, and so long as the smelters continue to operate, limestone will be in demand as a furnace flux.

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Safety Series No. 14

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State Safety News
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CHARLES F. WILLIS, *Director*

TUCSON, ARIZONA

1916-17

.....1916

J. T. MORE, Secretary,
SOUTHWESTERN MINE SAFETY ASSOCIATION,
Ray, Arizona.

Enclosed please find ^{money} order for Three Dollars (\$3.00)
_{check}
for membership in the Southwestern Mine Safety Association for
the year 1917.

Address.....
.....

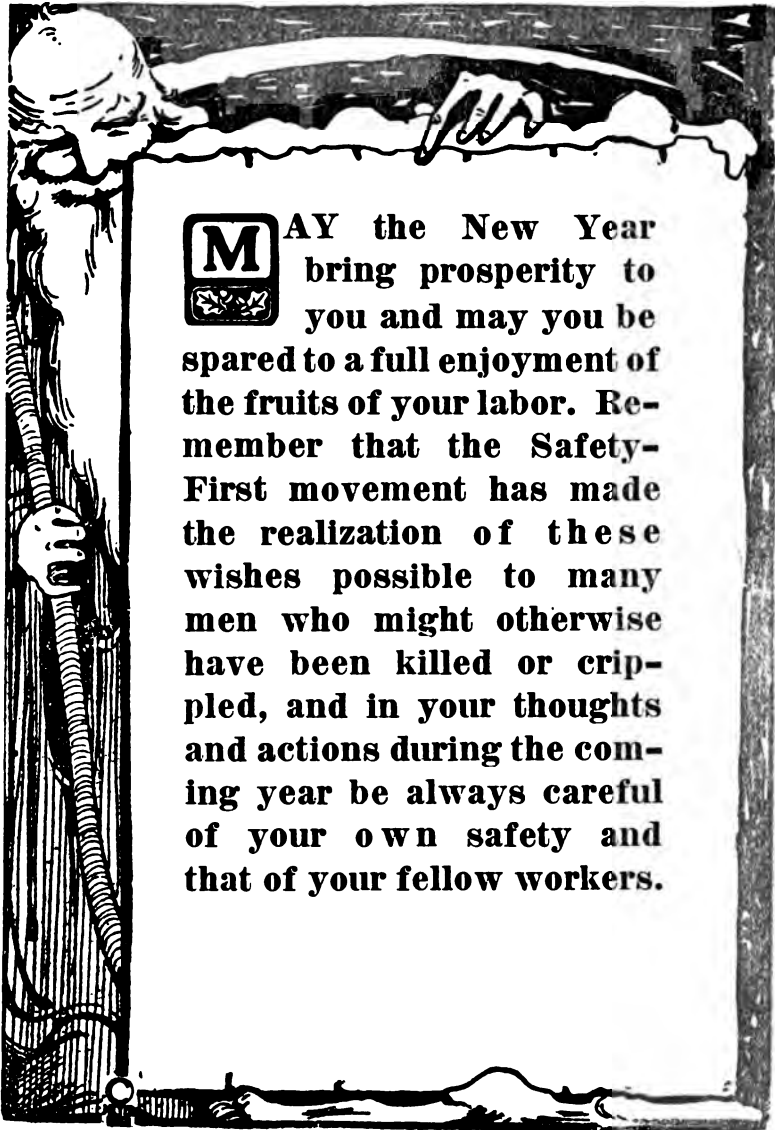
State Safety News

Safety

Efficiency

SAFETY SERIES No. 14

JANUARY 2, 1917



MAY the New Year bring prosperity to you and may you be spared to a full enjoyment of the fruits of your labor. Remember that the Safety-First movement has made the realization of these wishes possible to many men who might otherwise have been killed or crippled, and in your thoughts and actions during the coming year be always careful of your own safety and that of your fellow workers.

TAKING INVENTORY.

January is the month when business men take inventory and many people make new resolutions. It is probably well to have one time of the year to do this, but have you thought it is quite as proper to take an inventory of human qualifications as of stocks and goods. The greatest assets each man has, whether rich or poor, lie within himself, and he should analyze these assets so that he may see where he is weak so as to make himself strong.

Health is the principal asset of every man and should be jealously guarded. All bad habits should be avoided and clean lives lived in order to conserve this great blessing.

Perfect bodies and organs are necessary to take a man's part in the world's work. Therefore each man should promote safety and avoid accidents in order to save lives, prevent mutilations of the body and loss of eyes, arms, legs or other parts of the body.

Reputation for honesty, truthfulness and fairness does much to advance men to higher positions of trust and responsibility.

Training is necessary to develop the resources of the body and create health. Each man should utilize his spare time preparing for the job ahead by doing his work in a better way every day.

We'll never get anywhere unless we think some.

THIRD ANNUAL MINE RESCUE CONTEST.

The stellar attraction at the Arizona State Fair on November 14th was the annual First Aid and Mine Rescue contest given under the auspices of the Southwestern Mine Safety Association. The contest started at 9 o'clock, many being present to witness the demonstration which was considered the best ever attempted since this work was initiated in the mines throughout the state.

A mine constructed of heavy timbers was located on the fair grounds in such a way as to illustrate mine shaft tunnels, and other parts of underground workings, in order to have the contest take place under as practical conditions as possible.

Orr Woodburn, one of the prominent directors in the work, brought both a first aid and mine rescue team from the Old Dominion mine at Globe. J. T. More, the hustling secretary-treasurer of the Southwestern Mine Safety Association was always in evidence, with J. F. Newton, who had direct charge of the Ray men. Wallace (Safety) McKeehan was in charge of the Bisbee

crew. A. S. Livingston was a booster for the abilities of the Detroit Copper Co. team. Tom Cowperthwaite was there with the Calumet and Arizona rescue team, and S. F. French with the C. & A. first aid men.

These men represent the backbone of a movement which is financed by the operating companies of the state in a serious effort to reduce, not alone the dangers of mining, but also the suffering from injuries obtained during these operations.

The Old Dominion teams took honors, winning the first place in the mine rescue contest and second place in the first aid contest. These teams were as follows:

1st aid team: C. E. Griswold, A. S. Gifford, D. W. Cheney, H. W. Payne, A. Mugfond and L. Tabb.

Mine rescue team: Sam Boreland, Al. Wilkins, William Dennis, William Cowling, Charles Philips and Charles Askew.

The following are the scores in each of the contests:

Mine Rescue Contest	
Old Dominion.....	99 per cent
Calumet & Arizona.....	98.4 per cent
Detroit Copper Co.....	98 per cent
Copper Queen.....	90.8 per cent
First Aid Contest	
Calumet & Arizona.....	98.5 per cent
Old Dominion.....	97.75 per cent
Ray Consolidated.....	97.75 per cent
Copper Queen	97.1 per cent
Detroit Copper Co.....	95.45 per cent

The third annual contest was a success in every way, and the demonstration of the work done was highly commended by those present. The judges of the contest were Major Murray, Captain McClellan and Captain Parce of Douglas; J. C. Roberts, formerly of the U. S. Bureau of Mines; George W. Salisbury of Jerome, and H. H. Sanderson of Seattle.

*Aiming high is all right. But the careful
aimer is the one who is sure his gun is not
loaded with blanks.*

THE MAN WHO DELIVERS THE GOODS.

There's a man in the world who is never turned down, wherever he chances to stray; he gets the glad hand in the populous town, or out where the farmers make hay; he's greeted with pleasure on

desert sands, and deep in the aisles of the woods, wherever he goes there's the welcoming hand—he's *the man who delivers the goods*.

The failures of life sit around and complain, the gods haven't treated them white, they've lost their umbrellas whenever there's rain, and they haven't their lanterns at night; men tire of the failures who fill with their sighs the air of their neighborhoods; there's a man who is greeted with love-lighted eyes, he's *the man who delivers the goods*.

One fellow is lazy and watches the clock, and waits for the whistle to blow, and one has a hammer with which he will knock, and one tells a story of woe, and one, if requested to travel a mile, will measure the perches and rods, but one does his stunt with a whistle and smile—he's *the man who delivers the goods*.

One man is afraid that he'll labor too hard—the world isn't yearning for such, and one man is ever alert, on his guard, lest he put in a minute too much, and one has a grouch or a temper that's bad, and one is a creature of moods, so it's hey for the joyous and rollicking for—for *the one who delivers the goods*.—WALT MASON.

*'Tis not birth, nor rank, nor state—'tis get up
and get that makes men great.*

GERMS AND FILTH ARE CLOSELY ALLIED.

Because germs can not be seen it is difficult to protect ourselves from them. If it were easy, there would be much less sickness. One precaution that is perhaps more helpful than any of the others is to avoid all things unclean. Real cleanliness means many things. It means clean water, clean yards, clean milk, clean food, clean houses, clean air, clean bedrooms, and clean bodies. Long before we had any knowledge of germs instinct warned us to avoid unclean conditions. Now we have learned that germs and uncleanliness are closely related.

The throwing off of waste poisons is one of life's processes. Not only must the waste poisons get out of the body, but they must be kept away. They should be removed from all possible contact with the body. Man can not flourish in his own defilement.

In early times people did not remain in one place very long. They hunted and fished and then moved on, leaving behind their defilement.

If people can not move away from the defilement they cause, it must be moved away from them. The wholesomeness and healthfulness of the dwelling site depend upon how quickly the wastes are removed from near it.—W. S. B. OF M. BULLETIN.

NECESSITY FOR ORGANIZATION.

The accident prevention problem involves two essential elements—*Safeguarding* and *Education*—in each of which there is more or less detail work. Experience in the past decade has conclusively proven that safeguarding and educational work in any plant is not a “one man job”; that satisfactory results can only be secured through the highest measure of co-operation between the employer and his employees, and this only by means of organization. The employer himself must be vitally interested in the work if he expects to educate his men to share the responsibility with him. The men must be given a part to perform in it, if their interest is to be aroused and maintained. The problem must touch them somewhere, and they must be brought into direct relationship with their employer. It is only through organization that this is possible.

THE WORK OF AN ORGANIZATION.

The form and character of any organization must naturally vary as the work to be performed varies; hence the work to be done by a safety organization should first be considered before determining what the form of organization should be.

Safeguarding and *Education* comprise the task of any safety organization, all of which naturally requires efficient planning, direction and supervision.

In *Safeguarding* there are involved among others the following essential elements:

1. A study of hazards incidental to the use of equipment and machinery.
2. Adoption of standards.
3. Inspection for—
 - (a) *Need of safeguards.*
 - (b) *Installation of safeguards.*
 - (c) *Maintenance of safeguards.*
 - (d) *Use of safeguards.*
4. In new construction or replacement, checking in drafting room or purchasing department.

In *Educational* work there are involved among others the following essential elements:

1. A study of hazards incidental to operations.
2. Adoption of operating rules covering safe method of doing work.
3. Instruction of new men as to hazards and rules.
4. Interesting the men.
5. Providing bulletin boards, in the several departments, for the posting of Safety Orders, Rules and Information.

FORM OF ORGANIZATION

The existing working force of every industrial or transportation concern, whether large or small, is adaptable very readily to an accident prevention organization.

In any form of organization created the following elements are essential:

1. A safety inspector (who in a small plant may perform other duties). He should—
 - (a) Inspect—
 - (1) For need of safeguards.
 - (2) For installation of safeguards.
 - (3) For maintenance of safeguards.
 - (4) For use of safeguards.
 - (5) For unsafe practices.
 - (6) For plant cleanliness.
 - (b) Have charge of details of all safety work.
 - (c) Receive all reports, recommendations and suggestions.
 - (d) Keep all necessary records.
2. A central committee of safety composed of plant superintendent or his assistant (chairman), safety inspector (secretary), and three or more high grade department superintendents, foremen or workmen, which should—
 - (a) Have general charge and supervision over safety work.
 - (b) Pass on all matters of controversy.
 - (c) Gather all available information.
 - (d) Establish standards for safeguards.
 - (e) Promulgate rules for safe operation.
 - (f) Outline educational campaign.
3. Workmen's committees; consisting of three to five workmen, appointed and changed periodically. They should—
 - (a) Make inspections.
 - (b) Investigate accidents in their several departments.
 - (c) Render written reports on forms provided for that purpose.
4. Foremen: Each foreman should—
 - (a) Enforce safety rules adopted.
 - (b) Be held responsible for the safety of his men.
 - (c) Investigate accidents, reporting causes and suggestions for method of preventing recurrence on forms provided for that purpose.
 - (d) Make frequent inspections of his department.

(e) Render weekly written reports on forms provided for that purpose.

5. Meetings of foremen—held monthly to discuss safety matters.

6. Workmen: Each workman should be educated and interested in safety matters. This work involves—

(a) Instruction of new men.

(b) Familiarizing of men with rules.

(c) Interesting the men through bulletin boards, prizes, etc.

(d) Discipline.

In smaller plants and factories the development of the workmen's interest in safety and the utilization of his power of safety inspection can doubtless be obtained by a much simpler committee system.

Some people are dissatisfied with everything except the satisfaction they get out of being dissatisfied.—Dr. Push.

BOOZE ONE BUSINESS HELPED.

"If any man here," shouted the temperance speaker, "can name an honest business that has been helped by the saloon I will spend the rest of my life working for the liquor people."

A man in the audience arose. "I consider my business honest," he said, "and it has been helped by the saloon."

"What is your business?" yelled the orator.

"I, sir," responded the man, "am an undertaker."

*Teach the new man how to avoid accidents.
He may have a wife and family who love him.*

SOME FACTS ABOUT CARBIDE AND ACETYLENE.

Carbide is not inflammable.

Carbide is not explosive.

The residue from the used carbide is not explosive.

The gas from carbide is not exploded by concussion.

Acetylene gas is not poisonous.

Breathing small quantities of acetylene is not injurious to health.

The products of combustion of acetylene are not poisonous gases.

*A city can get along without some men, but
it cannot get ahead without them.*

ACCIDENTS AT COPPER METALLURGICAL PLANTS.

As the mills and smelters treating copper ores represent such an important part of the metallurgical industry of the United States, Tables 1 and 2 have been compiled from the reports of a number of selected companies whose records appear reasonably complete, and where efforts are being exerted to maintain safety organizations. These figures represent 16 ore-dressing plants and 20 smelters in various parts of the country, employing 8,056 men at mills and 9,417 at smelters. The fatality rate at these plants is reasonably low and the nonfatal injury ratios are seemingly not much in excess of those at quarries and the surface plants of mines. These figures are given in order that more specific information may be available concerning this important branch of the metallurgical industry.

TABLE 1.
SUMMARY OF ACCIDENT DATA AT COPPER METALLURGICAL
PLANTS, 1915.

	Mills	Smelters
Number of plants	16	20
Men employed	8,056	9,417
Number of 300-day workers	8,838	10,438
Total days' labor (shifts).....	2,651,313	3,131,577
Days worked during year	329	332
Number killed	10	15
Number injured	1,009	1,686
Fatality rate per 1,000, 300-day workers.....	1.13	1.43
Injury rate per 1,000 300-day workers.....	113.03	161.52

TABLE 2.
ACCIDENTS, BY CAUSES, AT COPPER METALLURGICAL PLANTS, 1915

	Mills		Smelters	
	Killed	Injd.	Killed	Injd.
Haulage system (cars, motors, etc.).....	1	51	3	150
Railway cars and locomotives	...	9	...	12
Crushers	...	6	...	3
Rolls or stamps	...	10	...	...
Tables, jigs, etc.	...	32	...	...
Cranes	...	...	2	23
Other Machinery	1	103	2	110
Falls of persons	3	146	2	167
Suffocation in ore bins	1	2	1	7
Falling objects (rocks, timbers, etc.).....	1	111	1	316
Cyanide or other poisoning	...	5	...	...
Gas (burning or asphyxiation)	...	...	...	2
Scalding (steam or water)	...	7	...	17
Electricity	1	19	1	24
Hand tools, axes, bars, etc.	...	133	...	219
Nails, splinters, etc.	...	57	...	49
Flying pieces of rock from sledge or crusher	...	40	...	...
Burns from matte, slag, or molten metal	...	...	2	201
Hot-metal explosions	...	...	1	53
Other causes	2	278	...	333
Total	10	1009	15	1686

THE KNOCKER.

There is a type of man who derives more pleasure from pulling down than in building up; in saying the unkind thing, rather than the kind; the sort of man who goes gladly forty miles out of his way if he thinks he can "put one over," says T. & T. Imprint. It takes a peculiar mental construction to gloat in "knocking"—a sort of self-hypnosis which makes the knocker think he is doing himself good by doing another fellow harm. The knocker believes that others like to hear his tale, that others take his story at its face value. But note the consistent knocker. He is seldom in business for himself; or, if he is, he hardly ever stays there. When he gets a job, he doesn't hold it; when he has a friend, he loses him. He has to buy for cash, for the knocker has no credit. Nobody trusts him, nobody believes him. The knocker does a lot of harm, but in the long run, it is only to himself. The man who knocks is always among the down-and-outs, the has-beens, the never-to-bes. The successful man ignores the knocker. He is too busy doing things.

*I think that saving a little child and bringing
him to his own is a derved sight better business
than loafing around the throne.*

ATTENTION, MARRIED BOOZE FIGHTERS!

To the married man who thinks he cannot get along without his drinks, the following is suggested as a solution to the bondage of his habit:

FIRST—Start a saloon in your own house.

SECOND—Be the only customer and you'll have no license to pay. Give your wife two dollars to buy a gallon of whiskey, and remember, there are sixty-nine drinks in one gallon.

THIRD—Buy your drinks from no one but your wife, and by the time the first gallon is gone she will have eight dollars to put in the bank and two dollars to start business again.

FOURTH—Should you live ten years and continue to buy booze from her, and then die with snakes in your boots, she will have money enough to bury you decently, educate your children, buy a house and lot, marry a decent man and quit thinking about you.

*The only safe place to put your money is in
the bank where it is safe from fire, burglars,
or your own extravagance.*

WHAT IS FIRST AID?**BY FRED B. KILMER.**

"The editor of *"Coal Age"* has submitted this question, "What is first aid?" Perhaps I can answer the query in part by stating what first aid does not embrace.

First aid in emergencies does not include the diagnosis and treatment of disease, the application of therapeutics or the practice of medicine or surgery. Persons skilled in all of these arts may practice first aid, but in practising and in applying these arts they are not exercising true first aid according to its correct definition.

As a matter of fact many eminent practitioners of medicine misunderstand the true meaning of first aid and either condemn it, or, in practising it and in imparting it to others, overstep its true sphere. Modern first aid as applied in the factory, workshop, mine, store, household or wherever it may be needed in simple life is a complement to first aid on the battlefield.

First aid to the injured from the viewpoint of the industrial worker has been aptly described as a bridge between the accident and medical and surgical assistance, and this bridge should always be kept in mind when speaking of first aid or when applying it. Over this bridge the injured person is to be carried from the place of injury to a place of treatment, and once the bridge is crossed and the injured person placed in the hands of a medical attendant or in the hospital, first aid is at an end. Thus we see that the true office of first aid is to relieve the injured person from immediate suffering and to prevent further injury.

FIRST AID WORK DOES NOT INCLUDE DIAGNOSIS.

Action of this character is first aid, whoever may render it. A person trained to this end, such as a mine worker who has had special instruction and who is perhaps a member of a first aid team, a physician or a nurse, may render such aid more skilfully than an untrained person, but in either instance the action here outlined is first aid in its beginning and in its end. It will therefore be seen that the permanent treatment and care of injuries, administration of medicine, the diagnosis and treatment of disease are not parts of first aid, and it is for the lack of a clear conception of that work as here outlined that much prejudice has arisen against the movement, and first aid has failed to make the progress to which it is fully entitled. In short, it has been overloaded and complicated and what it needs at the present time is to be stripped of the non-essential and brought down to its first and underlying principles.

The great apostle of first aid, the immortal Von Esmarch, invented the well-known triangular bandage, which is simply a triangular piece of cloth. This was used by him as the sole application for rendering first aid on the battlefield, and today efficient aid can be applied in all walks of life by the use of one of these simple pieces of cloth. Indeed, there are many systems in successful operation in the railways, mines, industrial institutions and in the armies and navies of the world the beginning and ending of which consist of the well-known first-aid packet which contains this triangular piece of cloth, a bandage and a few safety pins. There are few injuries encountered in the ordinary walks of life which cannot be treated with this simple application. In other words, the triangular bandage, or at times the first-aid packet, is all the first-aid worker really needs. Thus we see that even the hospital is out of place in mine or factory as an essential part of a first-aid equipment. In fact, it would be my judgment that a hospital should not be installed as a part of the equipment unless it is also supplied with a skilled staff of physicians, surgeons and nurses. The best use for a hospital in industrial institutions is as a place for rest and the rendering of medical and surgical treatment. It should be kept locked and made inaccessible except to a qualified attendant.

IN FRANCE A PAD AND A TRIANGULAR BANDAGE.

Experience in France during the present great conflict has shown that the most successful application of first aid is the covering of the injury with a pad and the application of the triangular bandage, leaving all other manipulation of the injured person for skilled attention at the hospital, which may be many leagues away.

Complications have arisen in first aid by reason of the various laws and regulations enacted by over-zealous but unenlightened legislators. Hence we have a law in one State which requires a first-aid equipment containing a given number of items, sometimes including dangerous and poisonous medicines and applications; on stepping over the line we meet another set of laws and regulations requiring an entirely different outfit. The legislation as to what should constitute a first-aid equipment passed by the State of Illinois marks what should be specified, though perhaps it is a minimum requirement. That State has prescribed that at least six regulation first-aid packets be provided for train service.

Owing to the misconception of true first aid and to the complicated systems which have been introduced in mines and industrial institutions, many men who might otherwise render efficient first-aid serv-

ice have become scared at the complicated array of equipments, rules, regulations, and instructions, and in consequence do nothing. Others, having acquired a little but dangerous knowledge, overdo the matter and become involved in the whole realm of diagnosis, treatment, therapeutics, medicine and surgery.

The point which I have attempted to impress in this article is that we should simplify our first-aid equipment and our instruction, service and application. The first aim is the immediate care of the injured in order that no extension of the injury may take place; the second aim is to transport the injured person as soon as possible and place him in the hands of a skilled medical attendant. This is where first aid becomes an adjunct to safety first—safety to the injured person, safety in the method of handling the injured person, safe transportation to a place where the injured person may receive proper treatment.—QUEENSLAND MINING JOURNAL.

Accidents are preventable only as the seed of caution is sown and men think and act in a safe way.

AMBITION.

It is not the lack of ambition that causes most of the inefficiency. Ambition is common enough, for we find it everywhere, in every man, no matter how low his state.

The trouble is that ambition frequently exceeds energy or ability.

With the average young man who enters a business, his ambition runs riot with his capacity to apply himself.

His ambition is always ahead of his immediate occupation.

He does not allow what he is doing to catch up with his ambition.

His mind is away from the immediate thing and thus we find inefficiency in the immediate thing.

For instance, the bundle boy in the big store: He is ambitious enough to become a clerk, and he is so busy thinking about the clerk's occupation that he neglects his own task and gets the articles in the wrong bundles. He is so intent on watching his superior, the clerk, that he will criticize a clerk's action in his method of handling a customer.

For instance, we nearly always find the inferior traveling salesman continually complaining of his sales manager and the policy of his house.

—ILLINOIS STEEL COMPANY SAFETY BULLETIN.

TEN COMMANDMENTS.

TO PREVENT ACCIDENTS AND PROMOTE SANITATION

1. Get the safety habit. Don't take chances. Learn all the rules; understand your work thoroughly. Study the dangers incident thereto and avoid them. Think before you act.
2. Do not work with defective chains, cables, tools, or appliances of any kind, or in an unsafe place. Carefully examine same and report dangerous conditions to your foreman.
3. Never work on a crane, trolley or other machinery until you have notified the operator and attached a sign, "Danger. Do not move," bearing your name, at the point where the power is turned on. No man except the man who placed it should remove such sign.
4. Do not turn on any electricity, gas, steam, air, acid or water, or set in motion any machinery, or throw down any material, without first seeing if anyone is in a position to be injured, and all safety guards are in their proper place.
5. Do not go onto an overhead crane runway, for any purpose, without permission from your foreman, and then not until the crane-men have been notified and a sign, "Danger. Men on Crane Track," hung in cage before crane-men. After notifying crane-men, attach bumping block to crane rail between where you are working and cranes. Use same precautions when working near crane tracks.
6. Wear goggles when working around circular saws, chipping, handling acid, cutting cables, working at emery wheels, etc.
7. Do not ride on, or operate engines, cars, cranes, elevators or other moving bodies, or tamper with electrical apparatus, unless authorized to do so. Never leave your regular place of work except when required by your duties.
8. If you make an opening, or remove the cover from any opening, in floor, ground, valve pit or sewer, guard that opening so no one can fall into it.
9. Do not pile any material so high that it is liable to fall, or cause any other pile to fall, or allow it to lean against walls too weak to bear the pressure.
10. Commit no nuisance, be clean and help to keep the plant clean. Conduct your private life so that you are at all times in the very best of physical condition, wide awake and active.

Learn from your mistakes, but don't cry over them. We best redeem the past by forgetting it.—Elbert Hubbard.

THE PROPER SLOGAN.

BY BERTON BRALEY.

This business of diggin' the copper
Is risky, at best, an' that's straight,
Which makes it exceedin' improper
To take extra chances with fate.
The man who with danger is flirtin'
Is lightin' a mighty short fuse,
Don't gamble with death, for it's certain
That sooner or later you'll lose!

Up at the collar or down in the stope,
"Safety First" is the wisest dope!

If timbers seem doubtful an' quaky
Don't "guess they will do for the day,"
If ground up above you is shaky
Don't reckon it "maybe will stay."
You want to watch out what your'e doin'
In manway or crosscut or drift,
Or else you may totally ruin
Yourself—or the feller next shift.

Out at the station, or in at the stope,
"Safety First" is the wisest dope!

There's many a widow in mournin'
There's many a sweetheart who cries,
Because of a man who was scornin'
The rules an' precautions that's wise.
So listen, you boys, to my carol,
So I won't be wastin' my breath,
Don't monkey with danger an' peril,
Don't gamble so reckless with Death!

For up in the smelter or down in the stope
"Safety First" is the proper dope.
—BY COURTESY OF "THE ANODE."

A careless man is dangerous to himself, his fellow workers and society. Eliminate him.

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***University of Arizona
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**Gems and Precious Stones
of Arizona**

BY
FRANK L. CULIN, JR.



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GEMS AND PRECIOUS STONES OF ARIZONA

BY FRANK L. CULIN, JR.

INTRODUCTION

Nearly all the known varieties of gems and precious stones are found in the United States, and several varieties are found in Arizona. Little systematic mining has been carried on for them, and no extensive search for them has been made, except in the states of Maine and North Carolina. In most cases, the discovery of gems in the United States has been accidental in connection with other substances that are being mined, or in small veins.

These gems are mostly sold in local markets; gem collectors and mineralogists also purchase them, for private collections, as a rule.

ARIZONA GEMS

The best known gems found in Arizona are the turquoise, garnet, peridot, chrysocolla, azyr-malachite, malachite, agate, chalcedony, amethystine quartz, diamond (meteoric) diopside and topaz.

Turquoise: Turquoise is a phosphate of alumina and copper. As a rule, it has greenish or light milky blue color; also it is commonly a dark blue, which fades on exposure. These varieties are hardly worth the cost of cutting. The gem stone should be a clear dark blue, which will not fade. When veined or mottled with the gangue matrix the substance is known as matrix turquoise. This matrix is usually as hard as, and even harder than, the turquoise itself. The color of the matrix should be pleasing, and harmonize with the blue of the turquoise.

Turquoise occurs as veins or vugs in acid igneous rocks. It seems to have been formed by deposition from warm waters, and is usually associated with altered rocks.

Garnet: Garnet is a complex silicate of calcium and aluminum, in which the calcium is frequently replaced by more or less iron and magnesium, and the aluminum, by chromium and iron. It varies in color from white to black-red, yellow, green and brown shades. The best quality garnets are dark red, free from specks and cracks or

other flaws. This variety is called pyropene garnet. When of a purplish tint, it is known as almandine. The brown variety is incorrectly called hyacinthe.

The precious garnet found in Arizona is known as the Arizona Ruby, although it is not at all related to the true ruby; it is as fine as any found in the world. They are gathered as worn, rounded pebbles, in gravel deposits in the northern part of the state, mostly by the Moqui Indians. The gem has not been found in place in this state, but was probably formed in basic rocks, such as peridotite. It also occurs in mica schist rocks in other localities, and may be found in such rocks in this state.

Peridot: Peridot is a clear pure crystalline variety of the mineral chrysolite or olivine, a magnesium-iron silicate. The best quality stones have a clear yellow-green tinge. It is usually brown or olive green (olivine) and rarely a clear golden yellow (chrysolite). The material from Arizona comes from altered peridotites, in the northern part of the state, near Ralkai and Rice. It is usually found in sands and gravels. Large good stones are hard to find. The stone is increasing in popularity.

Chrysocolla: Chrysocolla is a hydrous silicate of copper. It is not of much value as a gem stone unless it has been silicified. It is of a light blue color, usually, or it may be more or less mottled. It is found in many copper mines of the state, being very abundant in the Globe district.

Azurite and Malachite: Azurite and malachite are hydrous silicates of copper. Azurite is the blue carbonate, and malachite green. The two minerals are nearly always very closely associated, and the combination is known as azure-malachite. Malachite is most valuable when it shows rounded or oval workings and a silky lustre. These minerals are common in the copper mines of Arizona.

Agate: Agate is a variegated chalcedony which is a variety of quartz. The variegations usually take the form of bands, which, when parallel and of alternating colors, form onyx and sardonyx. When these variegations take the form of moss-like or dendritic growths, the mineral is called moss agate. It is usually formed by successive deposition in cavities in eruptive rocks. They are found in many places in the state; in place in lavas, in sands and gravels, and embedded in limestones.

Chalcedony: Chalcedony is quite common in Arizona, usually

of a bluish gray or buff color. The red variety, carnelian, and the green variety, chrysoprase, have not been found in Arizona. It is formed in rock cavities, and found in place or in sands and gravels. A variety of chalcedony known as "turtle-back" or moonstone has been found here. It shows a peculiar mottled appearance, when cut, resembling the back of a turtle. Chalcedony is often called moonstone when cut, but improperly so.

Amethystine Quartz: Amethystine quartz is a clear purple colored quartz. The best known occurrence is in the McConico district. According to the Mineral Resources of the United States for 1908, one crystal from this district was sold to Tiffany, of New York City, for \$59.00. The great objection to it as a gem is that it loses color. It is found in veins and vugs, often with silver and lead ores.

Diamond: The only diamonds found in Arizona are meteoric, and occur in meteoric iron found at Canyon Diablo, near Coon mountain, in the northern part of the state. The crystals are very small, and have no commercial value.

At one time, in 1870, a company was organized for the exploration of diamonds and other gems in Arizona and New Mexico. A great quantity of gems said to have been found in these fields was exhibited, and expeditions to the locality gathered approximately 6000 carats of rubies and 1000 carats of diamonds.

Topaz: Topaz is a fluo-silicate of aluminum, usually clear and colorless, but most valuable when golden yellow or blue in color. It is found in the northern part of Arizona. The golden yellow variety is very apt to fade.

METHODS OF EXTRACTION AND PREPARATION.

Most of the gems and precious stones found in Arizona are merely by-products of the mining of other substances, and are sorted out from poorer specimens. The turquoise, garnet and peridot are mined separately. There are several companies that have produced turquoise in Arizona. The garnets are gathered from the sand and gravel beds in which they are most commonly found.

In preparing precious stones for market, the best specimens are first selected, cleaned, cut in various shapes, and polished. Poorer specimens are also cut and polished, or they may be reserved for use in private and public collections.

THE GEM INDUSTRY.

There was a large decline in the gem industry in 1914, due to the restricted conditions imposed by the conflict in Europe. This decrease had not been expected, but nevertheless, almost all gems fell off in production; turquoise, however, showed an increase.

The total value of the gem production of 1914 was \$124,651. The following table shows the total value of the production of gems which, although found in Arizona, may or may not be produced in the state.

Agate	\$ 8,312
Amethystine quartz	255
Azurite	1,280
Chalcedony (Included with agate)	
Chrysocolla (Included with azurite)	
Diopase (Included with azurite)	
Garnet	1,760
Malachite (Included with azurite)	
Peridot	100
Topaz	1,380
Turquoise	13,370
Total	\$26,457

(Note. It is to be understood that this does not represent the Arizona production. No figures as to that are available.)

The value of the imports of precious stones into the United States in 1914 was \$19,211,084, showing a decrease of \$26,220,914 from 1913.

ESSENTIAL PROPERTIES OF GEMS.

Gems are certain minerals which, by reason of their brilliancy, hardness and rarity, are valued for personal decoration; the term is extended to include pearl. (Definition from *Encyclopedia Britannica*). In a restricted sense the term is applied only to precious stones after they have been cut and polished as jewels, while in their raw state, the minerals are conveniently called gem stones.

The general properties which determine the value of a gem are:

(1) hardness; (2) specific gravity; (3) crystalline form and cleavage; (4) color; (5) optical properties, refraction and dispersion.

(1) **Hardness**—A high degree of hardness is a desirable property of a gem, for no matter how brilliant and beautiful a mineral may

be, it is less valuable to the jeweler if it is not sufficiently hard to withstand the abrasion to which articles of personal use are subjected. (This statement does not apply to pearls and a few other gems.) If not sufficiently hard, the stone may be badly scratched; it will at least soon become dull by wear. An arbitrary scale of hardness has been adopted, with the diamond, the hardest known gem, placed at the top with a value of 10. The ruby and sapphire come next, with a value of 9; the topaz is placed at 8, and quartz at 7.

(2) Specific gravity: This property in itself does not directly affect the value of a gem stone, but it is very valuable in distinguishing one stone from another.

(3) Crystalline form and cleavage:: The majority of gem stones are crystalline in character. They lose their original crystalline form in cutting, but due to the crystalline structure, most gem stones have definite cleavage planes. This property is usually taken advantage of in dressing stones preparatory to cutting.

(4) Color: The beauty and consequent value of gems depend mainly on their color. Some stones, of course, as the diamond, are valued for absence of color, but this is the exception. Color is usually due to the presence of some foreign pigmentary matter, usually in small proportions. The coloring matter may be evenly distributed throughout the stone, or in regular zones, or in quite irregular patches.

(5) Optical properties: Refraction. The brilliancy of a cut stone depends on the amount of light reflected from its faces; in the form known as the "brilliant", the gem is so cut that much of the incident light, after entering the stone and suffering refraction, is totally reflected from the facets at the back. The amount of light which is thus returned to the eye of the observer will be greater as the angle of total reflection, or critical angle, is smaller, but this angle will be small if the refractive power of the stone is great; so that the brilliancy depends directly on the refractivity.

Dispersion: The play of colors exhibited by a cut stone, often known as its "fire", is due to the decomposition of the white light which enters the stone, and is returned, by internal reflection, after resolution into its colored components.

VALUE OF GEMS

Wholesale Prices:

Turquoise is worth up to \$100 a pound at the mine, in the rough, but usually is less valuable. Matrix material brings from \$5 to \$25 per pound. Cut matrix turquoise costs from 10 cents to \$10 a

carat. Cut clear blue turquoise costs from \$1 to \$10 a carat, the price increasing with size. When cut in large quantities, stones may be cut for three to five cents a carat.

Garnet is sold in the rough as single stones, and brings a price rather less than one fifth the price of cut stones. Cut pyropene garnets are worth from 50 cents to \$2 a carat, depending on the quality. Almandine garnets, if resembling the emerald, cost \$12 to \$15 a carat. The cost of cutting is \$1 to \$1.50 per carat.

Peridot is also sold as separate stones. Cut material runs from \$2 to \$15 a carat. \$5 usually buys a good stone. Cutting costs from \$1 to \$1.50 a carat.

Copper bearing stones, excluding high grade malachite, sell for about \$10 a pound. When cut, they are sold by the stone rather than by carat, and are sold so as to make a profit. No definite price can be set. They cost from five cents to ten cents a carat for cutting.

Chalcedony, unless of the turtle back variety, is hardly worth \$1 per pound. Cut material is barely worth the cost of cutting, which is 5 to 10 cents a carat. Turtle back variety may bring \$5 or more for a stone.

Amethystine quartz is almost valueless, except as mineral specimens unless it holds its color. The cut American material is hardly worth more than the cost of cutting. But foreign material may be worth \$4 a carat when cut. The cost of cutting is from 50 cents to \$1 a carat.

Topaz is bought by the single stone. Fine gem crystals, when colored, may be worth \$50 to \$100. Cut material, in dark blue shades, brings \$10 to \$25 a carat; the fine golden yellow brings \$4 a carat; diamond cut white stones bring \$1 to \$2 a carat. The cost cutting is about \$1 a carat.

ECONOMIC CONSIDERATIONS

With the exception of a very few valuable and highly prized stones, the production of gems is almost always more or less spasmodic. The cause of this is usually over production during a period of demand. This over production is often purposeful—as an example, the tourmaline mines of San Diego County, California, produce a large supply, which provides for the market demands for a time, and when this supply runs low, the mines are again operated until the stock is replenished.

In figuring upon a deposit of gems or precious stones, usual precautions must be taken. The product must, of course, be of good quality. The demand for the material should be known and a

market arranged for. The question of transportation does not enter, to any great extent, since the bulk is not large, and the quantity small.

FUTURE OF THE INDUSTRY

There is no question but that there will always be a large demand for gems. Aside from a few varieties, as the diamond, ruby, pearl, sapphire, etc., the demand is quite variable, but is always sufficient to repay small efforts in the production of various stones.

In Arizona the turquoise and garnet are sure of a wide market, at almost all times. Gems of the copper group, azurite, malachite, diopase, etc., will find a market, not always steady, but fairly so, especially with curio seekers.

Although there is, as has been seen, quite a wide variety of gems and precious stones in Arizona, one could hardly say that prospects of any great or continued production are good. What production there is will probably always be on a small scale.

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Miscellaneous Minerals

BY
P. E. JOSEPH



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MINERAL TECHNOLOGY SERIES No. 18

JANUARY 23, 1917

MISCELLANEOUS MINERALS.

BY P. E. JOSEPH.

ALUMINUM

Aluminum is the most widely distributed of all the metals, in igneous rocks averaging about 7.98%. Because of its great affinity for oxygen, most of its minerals occurring free in nature are the oxides and hydroxides. The important minerals of aluminum are:

Bauxite—hydrated oxide

Alunite—a complex hydrated sulphate of aluminum and potash

Alunogen—hydrated sulphate

Corundum—oxide

Ruby—red variety of corundum

Sapphire—blue variety of corundum

Emery—a mixture of iron and aluminum oxides

Cryolite—aluminum sodium fluoride

Gibbsite—hydrated oxide

Diaspore—hydrated oxide

Turquoise—hydrated aluminum phosphate

The most important ore of aluminum is Bauxite. Its chief uses are (1) as raw material for the extraction of aluminum; (2) in the manufacture of aluminum salts; (3) in the manufacture of bauxite bricks; (4) in the manufacture of aluminum for use as abrasives.

Geological Occurrence of Bauxite: Bauxite is found in the weathered zone of rocks associated with clays and kaolin from which it has been derived. Although clay and kaolin contain about 40 per cent alumina, their use as a source of metallic aluminum has not been found possible. The occurrence of bauxite in the United States is confined to Arkansas and the Southern Appalachian states.

According to the Directory of Arizona Minerals, published by the Arizona State Bureau of Mines, the occurrence of bauxite in Arizona, is unknown.

Prices: The average price of bauxite per long ton at the mines was, in 1911, \$4.82; in 1912, \$4.81; in 1913, \$4.75; in 1914, \$4.87.

Uses of Aluminum: The properties of aluminum, such as its low specific gravity, malleability, ductility, conductivity, and ease of al-

loying with other metals, make aluminum a very useful metal, and the demand is growing very rapidly. Its chief use is in the manufacture of kitchen utensils, surgical appliances, jewelry, fancy articles, in the manufacture of novelties, bearings for machinery, electric wiring, etc., and in the production of a number of alloys with other metals, such as copper, zinc, antimony and silver.

The other minerals of aluminum are used as gems, as abrasives and in the manufacture of alums.

PLATINUM.

Platinum is a very rare mineral, its sources in the world, and especially in the United States, being comparatively few. Its properties, however, are such as to cause a great demand for it, both in scientific work and for the manufacture of jewelry.

The minerals of platinum are:

1. Native platinum.
2. Sperrylite or platinum arsenide.
3. Platiniridium, an alloy of platinum and iridium.
4. Osmiridium, an alloy of osmium and iridium, carrying platinum.

The most important of these is sperrylite. Platinum occurs in small quantities in the gold bearing sands of California and Oregon, and in limited quantities in Arizona, Colorado, Georgia, Idaho, Nevada and Montana.

Geological Occurrence: Platinum occurs in nature as a result of the crystallization of magmas. As a native metal it is associated with chromite in peridotites; as sperrylite, it is associated with sulphide minerals of magmatic origin in gabbros and diabese. The platinum in the placers forms small rounded dark grey pieces, associated with occasional bright silvery flat pieces of osmiridium. Prospecting for platinum should be confined to the placer gravels of the serpentine rocks, especially those resulting from the metamorphism of large masses of peridotite, and to nickeliferous peridotite.

Production: Nearly all the platinum of the world is derived from placers in the Ural mountains in Russia, although smaller quantities come from Columbia, California, and New South Wales. Although the occurrence of platinum in Arizona is known, no production of the metal from this state has ever been recorded.

The following table gives the prices of ingot platinum per troy ounce at New York for the calendar years 1913 and 1914:

Month	1913 Price Per Troy Oz.	1914 Price Per Troy Oz.
January	\$45.50	\$43.38
February	45.50	43.50
March	45.50	43.50
April	45.50	43.50
May	45.50	43.50
June	45.50	43.50
July	45.50	43.50
August	44.90	50.20
September	43.96	50.20
October	44.00	49.50
November	43.70	45.45
December	43.45	42.19

In 1915 sales in New York have been made at \$85 to \$95 per ounce.

TIN

The principal use of tin is for the manufacture of tin plate, sheet iron coated with tin, which is used for making cans, household utensils, etc. Tin is also largely used in alloys, such as bronze, bell metal, pewter, solder, and tin amalgam. Tin foil is also made from it.

The ores of tin are:

1. Stannite, which is a sulphide of copper, tin and iron.
2. Cassiterite, tin oxide. (Several varieties of cassiterite are known.)
3.
 - a. Tin stone, which consists of crustals in granular masses.
 - b. Wood tin, occurring in radiating and fibrous masses, closely resembling wood.
 - c. Stream tin, occurring as rounded pebbles and grains in alluvial deposits.

Geological Occurrence: The most important ore is cassiterite, and it originally occurs in pegmatite dikes in granite, and in high temperature quartz veins in granite. From either of these sources it may be set free by weathering and disintegration, and, on account of its high specific gravity, it easily becomes concentrated in gravel deposits of different types.

Production: The only domestic production of tin in 1914 was made in Alaska, and except a small quantity produced from the lodes on Lost River, was stream tin. The following table shows the production of tin in the United States during the period 1911 to 1914 in short tons:

1911	51,892
1912	56,556
1913	51,017
1914	48,505

No production of tin from Arizona has ever been recorded.

The following table shows the prices of Straits tin in New York for several years, average monthly prices in cents per lb:

Month	1909	1910	1911	1912	1913	1914
January	28.13	32.74	41.39	43.24	50.25	37.74
February	28.30	32.96	42.83	43.46	48.63	39.93
March	28.74	32.49	40.76	42.86	46.83	38.08
April	29.48	33.02	42.20	44.02	49.12	36.10
May	29.16	33.18	43.10	46.12	49.07	33.30
June	29.32	32.84	46.16	47.77	44.82	30.65
July	29.17	33.04	42.96	44.75	40.27	31.75
August	30.04	34.10	43.45	45.87	41.66	50.59
September	30.35	35.23	39.98	49.18	42.37	32.79
October	30.50	36.63	41.21	50.11	40.41	30.39
November	30.90	36.68	43.13	49.90	39.80	33.50
December	33.06	38.28	44.97	49.90	37.62	33.60
Average	29.76	34.27	42.68	46.43	44.22	35.17

CADMIUM

The only cadmium mineral is the sulphide greenckite.

The chief output of cadmium comes from the zinc producing regions of Silesia, where it is recovered as a by-product in the distillation of zinc. No cadmium is recovered in the United States in the distillation of zinc ores, but most of the output is gained from bag-house fumes of lead smelters, which treat lead ores containing more or less zinc. The cadmium output in the United States comes in two forms, metallic stock cadmium and the pigment cadmium sulphide, "cadmium yellow."

Uses of Cadmium: Cadmium is used in the manufacture of yellow pigments in photography. It is used extensively alloyed with other metals, in the manufacture of sterling silverware, in britannia ware, and for soldering german silver. With tin it is used in cadmium plating, and with mercury, it is used as an amalgam in the filling of teeth.

Prices: The average price of metallic cadmium per pound as based on sales was about 90 cents in 1914. It is now quoted in New York at \$1.50 per pound.

NICKEL

No nickel ores are known to have been mined as such in the United States in 1914, but an equivalent of 845,334 pounds of metallic nickel, valued at \$313,000, is understood to have been saved as a by-product in the electrolytic refining of copper.

The ores of nickel are:

1. Millerite, the sulphide.
2. Pentlandite—iron-nickel sulphide.
3. Niccolite—the arsenide.
4. Annabergite—the arsenate.
5. Garnierite—the silicate.

Uses of Nickel: The uses of nickel are many, but its most important one is in the form of an alloy with copper and zinc in the manufacture of german silver. An alloy of nickel and copper is used in coinage, both in the United States and in Europe. Nickel and aluminum are of great commercial significance.

Prices: Nickel is quoted at 45 to 50 cents per pound, New York, for ordinary forms, with 5 cents per pound more asked for electrolytic nickel.

COBALT

No cobalt is known to have been produced in the United States in 1914. Most of that used by steel manufacturers in the United States has been imported.

The ores of cobalt are:

1. Linnaeite—cobalt pyrites.
2. Cobaltite—sulph-arsenide.
3. Smaltite—cobalt-nickel arsenide.
4. Erythrite—a hydrated arsenate.

Uses of Cobalt: Metallic cobalt finds little application in the arts and industries. Cobalt steel has a high elastic limit and tensile strength, but it is far more costly to manufacture than manganese or nickel steel, and therefore does not possess so wide an industrial application. It is used extensively as a pigment in the manufacture of glass and pottery. Sympathetic inks are made from cobalt acetate and cobalt nitrate. Cobalt and potassium nitrate are used as an oil and water pigment for painting on glass and porcelain. Cobalt nitrate is used in medicine. Cobalt is used also in the manufacture of gold and silver ornaments.

Prices: Cobalt has been quoted as high as \$1.25 to \$1.50 per pound for 95 per cent pure metal.

ARSENIC

Arsenic is a very common constituent of metallic minerals forming arsenides, arsenates, sulpharsenides, etc. It is found native in small quantities and is considered a secondary mineral.

The ores of arsenic are:

1. Realgar—sulphide.
2. Orpiment—sulphide.
3. Arsenolite—oxide.

The other minerals containing arsenic have been previously described, the most important and plentiful being arsenopyrite.

In 1914 the output of white arsenic or arsenious oxide in the United States amounted to 4,670 short tons, valued at \$313,147.

Prices: The prices of arsenic during 1914 ranged from 2.9 to 3.6 cents per pound on board the cars at works. The price of white arsenic during the year ranged from $2\frac{7}{8}$ cents a pound at the beginning of the year to 5 cents at the end of July. After war broke out the price rose to $5\frac{1}{2}$ and 6 cents a pound in September, from which it gradually declined to $3\frac{7}{8}$ cents at the close of the year.

BISMUTH

The only bismuth produced in the United States was obtained as a by-product in refining lead bullion by the United States Metals Refining Co. at Grasselli, Indiana, and by the American Smelting & Refining Co. at Omaha, Neb. Some residues rich in bismuth were saved in corroding lead by the National Lead Co. and by the Matheson Lead Co.

The minerals of bismuth are:

1. Native bismuth.
2. Bismuthinite—sulphide.
3. Tetradyomite—telluride.
4. Bismutite—carbonate.
5. Bismite—oxide.

The uses of bismuth are chiefly dependent upon its property of forming easily fusible alloys with other metals, especially tin, lead and cadmium. These alloys expand in cooling and are used in reproducing woodcut, in making safety plugs, etc. The salts of bismuth have many uses in medicine and in the arts; they are used in calico printing, cosmetics, and in making glass of high refractive power, also to impart lustre to porcelain.

The current New York quotations are \$4 per pound.

(NOTE: For a description of and tests for the various minerals mentioned in this bulletin, the reader is referred to Bulletin 41, Arizona State Bureau of Mines, which may be obtained by writing Charles F. Willis, Director, Tucson, Arizona.)

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1916-17



State Safety News

Safety

Efficiency

SAFETY SERIES No. 15

JANUARY 30, 1917

THE JOSEPH A. HOLMES SAFETY ASSOCIATION

The great service of the late Dr. Joseph A. Holmes to humanity is universally recognized. His death on July 13, 1915, left his life work well begun, but only begun. Appreciating the great importance of his work for better mining conditions and more friendly and co-operative relations between operator and miner and in order to keep up this good work and perpetuate his efforts and memory, the American Institute of Mining Engineers and the American Mining Congress immediately after his death appointed committees to give proper consideration to the subject.

See also...

This movement resulted in an invitation to all national organizations and metallurgy, as well as certain other aims of which Dr. Holmes was intensely interested. Committees, with the result that representative societies, named on the list attached, national societies, acting together, have formed the Safety Association.

Effectuated at meetings held in the city of New York, 1916, and March 4, 1916, at the latter meetings officials were elected:

W. C. Clegg, Director, Bureau of Mines;

W. D. Walcott, Secretary, Smithsonian Institution;

Samuel Gompers, President, American Federation of Labor;

W. H. Jennings, American Institute of Mining Engineers;

W. H. A. Brashear, President, American Society of Mechanical Engineers, forms the Executive Committee of the organization.

Consideration and discussion of the work of the Association were the order of business at these meetings.

OBJECTS OF THE ASSOCIATION

The singleness of purpose and nobleness of character of Dr. Holmes were well stated by the President of the United States when he said:

"In the death of Dr. Joseph A. Holmes the country has lost a public servant of unusual character and of singular devotion to duty. We are often called upon to note the career of some public benefactor, but we do not often enough note the services of the devoted men who, with little compensation and little public fame, seek to advance the interest of their fellow-countrymen through services of the departments of the Federal Government at Washington. Dr. Holmes was one of the most distinguished and most serviceable of these. He devoted his whole time and thought to turning science to human and generous use."

It should be remembered that the life aim of Dr. Holmes was to increase the safety and welfare of mining men. This motive was the inspiration for his development of the Mining Department at the World's Fair at St. Louis, of the Technologic Branch of the Geological Survey of the National Bureau of Mines.

The saddest and greatest feature of his loss was that the magnitude of his plans for benefiting mining carried him beyond the limits of physical endurance. He gave his life in personally carrying out work that should have been divided among many.

At the meeting on March 4, after careful consideration of various forms of memorials, the views expressed at the previous meeting were confirmed and it was decided that, as increased safety in mining had been the great aim in the latter days of Dr. Holmes' busy life of public service, the greatest and best memorial to him would be the living one which would aid in attaining this great end. Accordingly, the following was adopted as representing the purposes of the Joseph A. Holmes Safety Association:

1. That annually there be awarded one or more medals, with honorariums, to be known as the Holmes Award for the encouragement of those originating, developing and installing the most efficient safety-first devices, appliances or methods in the mineral industry during the previous year. These awards to be the result of reports and investigations by the secretary and the representatives of the association.

2. That once a year a meeting will be held in the City of Washington at which these awards will be made and to which the recipients will be invited, the awards being announced publicly at a dinner or meeting which may be held at the time of the annual meeting of the representatives of the societies making up this association.

3. That the executive committee, at its discretion, may make awards of suitable medals for personal heroism or distinguished service or the saving of life in any branch of the mineral industry, such

medals being of small intrinsic value, but suitably inscribed with the name of the recipient and the nature of his service. These medals to be presented publicly, with appropriate ceremonies, through the medium of the field representatives of the Bureau of Mines or other suitable agency at the mining camp, town, village or city nearest the mine, smelter or other establishment in which the act of heroism or service was performed.

It is believed that the objects appeal not only to the large operator and capitalist, but also to every miner and worker in the mineral industry, which is one of the great basic industries of the country.

It is hoped that the contributions which are now being asked will be as widespread as the industry.

To this end you are asked to contribute such sum of money as you may wish to give towards this laudable purpose and such advice and help as you may be inclined to give.

It is expected that annually there will be published a report concerning contributions and giving a list of the individual contributors (unless they desire that their names be not given) and the sums, together with a report of the awards and the work conducted under the auspices of the association.

Very respectfully yours,

DAVID T. DAY,
Secretary,

THE JOSEPH A. HOLMES SAFETY ASSOCIATION.

There is nothing costs so little and goes so far as courtesy.

PNEUMONIA

February is one of the worst months for this dread disease which kills so many people every year. To avoid it—

1. Do not drink alcoholic liquors.
2. Dress warmly, but not too thickly.
3. Do not needlessly expose yourself.
4. Have abundant fresh air in your living and sleeping rooms.
5. Do not have rooms too hot and then go into the open air unprotected by wraps.
6. Avoid over-eating and keep your bowels open.
7. Keep your feet warm and your head cool.

—KANSAS HEALTH BULLETIN.

Wise men change their minds, but fools never.

THE DRINKS THAT JACK TOOK

These are the drinks that Jack took.

This is the kick that lurked in the drinks that Jack took.

This is the haze that followed the kick that lurked in the drinks that Jack took.

This is the jag that emerged from the haze that followed the kick that lurked in the drinks that Jack took.

This is the fight that came from the jag that emerged from the haze that followed the kick that lurked in the drinks that Jack took.

This is the club in the hectic fray that stopped the fight that came from the jag that emerged from the haze that followed the kick that lurked in the drinks that Jack took.

This is the cop with the crude, harsh way that swung the club in the hectic fray that stopped the fight that came from the jag that emerged from the haze that followed the kick that lurked in the drinks that Jack took.

This is the cell in which Jack lay that was locked by the cop with the crude, harsh way that swung the club in the hectic fray that stopped the fight that came from the jag that emerged from the haze that followed the kick that lurked in the drinks that Jack took.

This is the morning so cold and gray that dawned in the cell in which Jack lay that was locked by the cop with the crude, harsh way that swung the club in the hectic fray that stopped the fight that came from the jag that emerged from the haze that followed the kick that lurked in the drinks that Jack took.

This is the job that he lost next day that followed the morning so cold and gray that dawned in the cell in which Jack lay that was locked by the cop with the crude, harsh way that swung the club in the hectic fray that stopped the fight that came from the jag that emerged from the haze that followed the kick that lurked in the drinks that Jack took.

And thus was started the slow decay that began with the end of the job next day that followed the morning so cold and gray that dawned in the cell in which Jack lay that was locked by the cop with the crude, harsh way that swung the club in the hectic fray that stopped the fight that came from the jag that emerged from the haze that followed the kick that lurked in the drinks that Jack took.

The most useless and in the long run the most unhealthy individual is the man with nothing to do.

LOSING A GROUCH

Perhaps you overslept a few moments this morning; perhaps you were out late last night; perhaps you lost your temper yesterday and the toxic poison then generated spoiled your night's rest; anyway, you started the day with a full-sized grouch.

You did not have time to shave and take your limbering-up exercise, so you cut out your morning breathing stunts. Your breakfast did you little good and you left the house feeling very dissatisfied with the good old world.

It is two blocks to the street car line and when you reached the corner the car was half a block away. You are pursued by fate, but—

Did you ever try this: Walk to the next corner and take the car there; or, better, walk two blocks. This, together with the distance to the car line will give you a chance to get the grouch-poison out of your system before you reach the office.

The office boy can tell you the athletic record for 100 yards—about a city block—can you approximate your time for the same distance? You are too dignified to run, even if your lung power is sufficient for the distance, so you walk. How do you walk? Erect, shoulders back, taking up the jar by using the muscles of the legs as springs? Or do you just walk?

You should be able to cover the block in 60 seconds. If you pay attention to your breathing you can cover the distance in twelve breaths; after a little practice, in six. That is, inhale for five or six steps and then exhale for the same distance. Soon you will be able to count ten steps for the intake and ten steps for the exhaust. This makes a game of walking. Try it. Your work will be a game all morning, and, better still, you will smile while you are hitting the hard spots.

Do this and the morning flirtation with My Lady Nicotine will be postponed till the luncheon hour. Not much use advocating exercise during the noon hour, although a walk around the block is a valuable addition to your preparedness program.

In the evening you should walk a mile before supper. If you live too far away to walk the entire distance from the office to your home, you can, at least, walk part way. Walk rapidly, but do not strain the body or the lungs—work up to it gradually. If you are really tired when you reach home, rest a few moments before starting your supper. Don't hurry over this meal. Afterward, rest for a time before you take further exercise, either doing chores about the house or in the open air.

Rest again for a little while before retiring. Be careful not to lose your temper—this generates a poison which adversely affects your body.

Keep your temper; exercise enough to protect your health (10 minutes a day will do); keep the body clean inside and out, and live the Biblical span.

Safety requires watchfulness.

WATCH YOUR TEETH

Your stomach has no teeth. If you don't chew your food before you swallow it you make your stomach do work that it isn't made for. It may do it for a time, but sooner or later it will go on a strike. Then you will have stomach trouble. You can't chew your food unless you have good teeth. Take a look at your teeth. How many need repairs? Go to a man who repairs them. A little attention now may save a tooth that otherwise will be lost in a month or two. Keep your teeth in good condition. Do you know what makes teeth decay? Much decay is caused by allowing small pieces of food to stick in and around the teeth and by allowing germs to stay there by not cleaning the teeth well. Get a toothbrush and clean your teeth well every day.

Give your stomach a chance.

Before you eat wash your hands and face. Don't eat dirt. Sit down, make yourself comfortable, take your time, and chew your food well. Eat slowly; your stomach will do better work if it is not speeded up. Don't drink too much water when you are eating. Don't drink a lot of cold water at once; it chills the stomach and may cause cramps. Drink a little water at a time and drink many times. Don't drink water that is too cold.

Do not use tools with mushroomed heads.

SAFETY OF A MINER'S PLACE OF WORK

The legal principle that an employer is bound to use a reasonable degree of care to see that the places where his employees are required to work are kept reasonably safe does not apply to case where the employees are engaged in making the place of work, as where miners and trammers are engaged in taking ore from a stope; and hence, in such a case, the mining company is not liable for injury to a miner on the theory of failure to provide a safe place of work. (Michigan Supreme Court, Kochin vs. Superior Copper Co., 148 Northwestern Reporter 252.)

ARE CHANGE HOUSES POPULAR?

It has been stated that the miners would not and do not take advantage of wash and change houses after they have been erected. Companies holding back because of this belief can have reasonable assurance that a modern wash and change house will be used by a large percentage of the men. Information that has been obtained concerning several thousand miners who were provided with wash and change house facilities shows that an average of about 85 per cent of the total number on pay roll used the wash and change houses daily. In a large number of the cases reported there was a fee, varying from 50 cents to \$1 per month for the use of the wash and change house. One company making a charge of 50 cents a month for the use of lockers and the bath privileges claims that the charge causes the men to make better use of the facilities provided. At the outset there will be some who will not use it, as miners, particularly the older ones, take slowly to innovations. The users steadily increase.

Some of the earlier wash and change houses were not kept clean or properly maintained, and so fell into disfavor. Their equipment was such as to breed and spread vermin. Warm water was not always available, and fixtures were often out of repair or so inadequate that much time would be wasted in taking a bath.

Facilities at the wash and change house should be such as to cause the miner no more delay than is necessary. There is necessarily going to be some additional time used.

Charges have also been made that the wash and change houses have been abused and subjected to all kinds of vandalism by the users. Such reports are said to have discouraged some companies who have introduced the houses from extending them to their other operations. This condition is unfortunate, and, as with many other privileges, the misdeeds of a few cause numerous innocent ones to suffer. An attendant should always be in charge of a wash and change house, so that the acts of vandalism of a few—perhaps four or five out of a hundred—can not discredit the large number that appreciate and are benefited by this worthy improvement.

There is no success without loyalty. The man who is disloyal to his work, to his employer, or to his fellow-man, is disloyal to himself and to all that is good in him—and therefore cannot succeed.

CARE OF THE FEET.

BY ROBERT ANSLEY, M. D.

Few people seem to understand the great importance of proper care of the feet. Often severe pains in the limbs, fatigue and nervousness are due to diseased, deformed or neglected feet. It is essential that feet be bathed frequently and it is very beneficial to bathe them daily.

Shoes should fit well, being neither tight, loose nor short. They should be kept in good repair and have heavy soles to provide protection from the weather and prevent injury to the feet due to nails running into them, etc. High shoes support the ankles and are preferable to low shoes. The alternate wearing of two pairs of shoes and frequent changing of stockings is highly desirable. Men working with molten metal or other hot materials should wear Safety Congress shoes which can be easily removed—Sheet Mill men should wear guards on their shoes to prevent sheets cutting their feet.

Flat foot, causing pains similar to rheumatism, is due to a breaking down of the arch of the foot. It is caused by ill-fitting shoes, lifting heavy weights, standing a long time in the same position, etc. Persons having flat foot and those whose work might cause same, or men whose shoes absorb a great deal of grease and thus furnish no support to the arch, should wear arch supporters.

Corns and callouses are caused by friction and pressure and will disappear when the cause is removed. Razors used to pare corns should be sterilized and care should be taken to avoid infections.

Ingrowing toe nails are caused by cutting away the side of the nails. When cutting nails avoid cutting sides of nails. The only way ingrown nails can be cured is by a slight surgical operation.

The best treatment for sweaty and ill smelling feet and also to relieve tired aching feet is to bathe them daily in a weak solution of alcohol.

Small neglects are apt to cause serious accidents.

DUTY OF EMPLOYEE.

The wisdom of guarding and protecting dangerous features in the industrial plants is very apparent from the viewpoint of the employer and should also be endorsed and assisted in by the employee. For while pecuniary compensation relieves the injured workmen and his dependents from actual want, and prevents them from becoming a

burden on society, it does not restore a life or rebuild a broken frame. Prevention of the accident is far better than any possible assistance after the accident has occurred. Precaution is less burdensome than regret. There is beyond the question of "Safety Provisions" a pronounced obligation on the part of the employee to reduce or eliminate the possibility of preventable accidents. To the workman the preservation of life and limb should be an ever present influence to stimulate caution. This should be a personal matter with thoughtful men in every kind of employment. Familiarity with danger too often results in the relaxation of caution, with the result that accidents happen that could easily have been avoided. The employee should at all times be cautious, with mind and thought constantly alert to prevent the accidents which so often occur from thoughtlessness and carelessness.—(REPT. MONT. IND. ACCIDENT BOARD.)

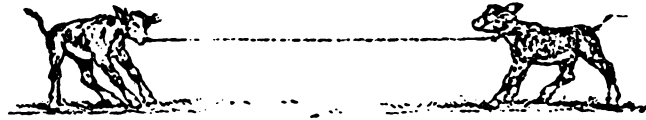
*You have no right to take a chance. The other
fellow may have to take the consequences.*

ACCIDENT PREVENTION SCORE BOARD

An interesting and novel plan for stimulating interest in the safety first movement is used at the plant of the Dodge Mfg. Co., Mishawaka, Ind. It consists primarily of a contest between foremen as to which shall make the best monthly and annual showing from a safety viewpoint, and its outstanding feature is a score board 24 feet long, standing just inside the main gate of the factory, on which are shown the departments, foremen, percentages for month and year, and rank of the various competing divisions. The starting point is 1000, both for year and month, and each division is penalized according to its accidents, minor accidents of less than one day's absence not being considered. Each day's absence bears a percentage charge in proportion to the total number of "man-days" per month per division.

The use of this scoreboard has resulted in the fostering of great interest among individual employees and foremen. Department loyalty has shown itself to be the foundation upon which the whole plan rests. Although it was originated for the use of an industrial concern, there seems to be no good reason why it could not be applied to mine, mill and smelter organizations.

*We can't all be learned and great; but all of
us should be wise enough to keep clean.*



HO-HO!



HOW?



WHEN?



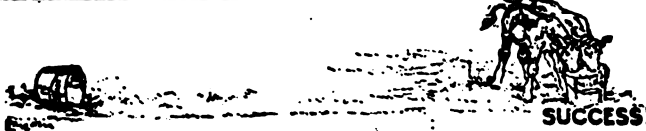
WOW!



LET'S PULL TOGETHER



TEAM WORK -



SUCCESS!

CO-OPERATION
[Courtesy of Armour & Co.]

Bulletin No. 51

Sampling Series No. 1

University of Arizona
Bulletin

**Sampling and the Estimation
of Gold in a Placer Deposit**

BY
GEO. R. FANSETT



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SAMPLING SERIES No. 1

FEBRUARY 20, 1917

SAMPLING AND THE ESTIMATION OF THE GOLD IN A PLACER DEPOSIT

BY GEO. R. FANSETT.

The sampling and the estimation of the gold present and recoverable play a very important part in the history and development of all placer deposits. For this reason everyone interested in placer mining should know the best methods of working this class of mineral deposit. The purpose of this bulletin is to indicate and describe to the miner and to the layman the best general methods used, so that they may understand and know how to do each and every part of the work, as well as to make the necessary calculations.

The work may be divided into three general subdivisions, namely: (1) The Sampling of the Deposit, (2) The Testing of the Samples, and (3) The Estimation of the Total Gold Present and the Gold Recoverable in the Deposit.

A placer is a deposit of mineral-bearing gravel, sand or soil. The commonest forms referred to are gold placers, tin placers, and platinum placers. The same method of procedure can be used in any kind of placer, but this bulletin particularly refers to gold placers, as they are the most common and of the most importance in the United States.

A sample is a collection of fragments or pieces from a deposit which contains exactly the same minerals in exactly the same proportions as they exist in the deposit. The act of collecting these pieces or fragments is called sampling.

The gold present is the amount of gold actually existing or present in the deposit. Gold is sold at the rate of \$20.67 per ounce Troy, but results from assayers are calculated at the rate of \$20 per ounce Troy. The ton used is the short ton of 2000 pounds avoirdupois. The value of silver fluctuates so that no definite value is given.

The gold recoverable is the amount of gold which can be extracted from the deposit by the use of any of the well known processes, such as a pan, sluice box, concentrator, centrifugal separator, dry washer, or any other process of ore dressing. There are always losses in this work, and for this reason the gold actually recovered is always less than is present in the deposit.

Sampling is slow work, and the greatest care is absolutely necessary and must be used in every detail of the work. Slipshod, careless work is absolutely out of the question, because if any one part of the work is not properly done, the collection of fragments obtained will not be a true sample of the deposit, and is not only valueless for the purpose intended, but will result in an incorrect estimate of the deposit.

RECORDS.

In the sampling of placers it is necessary to keep a good set of records, so that any questions which may arise can be correctly answered and definitely settled. For this purpose a topographical map, a sample book, and a diary are used to record all matters connected with the sampling of the deposit. These must be very carefully kept, as from one or all of them important points have to be decided.

If there arises a question in one's mind as to where to record a certain detail which seems to belong in two of the records, record it in both of them; and if it seems to apply to all of the records, record it in all of them, and do not consider it useless repetition—any matter worth recording is worth finding easily.

THE TOPOGRAPHICAL MAP.

A topographical map is made of the entire deposit as soon as a thorough preliminary examination has been completed. This map should be made to a scale large enough so that all details can be plainly marked.. All distances for this map are measured on the horizontal. All elevations are calculated from a permanently fixed benchmark or datum.

When the location of a test pit or hole is decided upon and work started, the location, together with the number given to it, is marked on the map. Likewise, when a test hole or pit has reached bedrock, the elevation of the bedrock is recorded. On the map is also recorded, by their numbers, the location of each of the samples, and, after they have been assayed, the values obtained. This map is used to record everything of this nature concerning the deposit, and should be so well kept that its records, together with those kept in the sample book and in the diary, will answer all inquiries which may come up.

THE SAMPLE BOOK.

Supplementary to the topographical map a sample book should be kept. In this book all records and details pertaining specifically to

each sample are recorded, such as the name of the deposit, number of the sample, its location, the date when taken, kind of soil, assay returns, etc., etc.

A convenient form of sample book is one which has a page which is perforated near the far end so that this end part or tag can be easily torn off. The number given the sample is written on the part of the page which remains in the book and also on the detachable part. The sample book should be kept so that the information in it, together with the information on the topographical map and in the diary, will answer all possible questions which may come up regarding the deposit.

The form on following page represents one of the pages used in a sample book, but this form should be changed if necessary to meet the requirements of any particular job.

DIARY.

Together with above records a diary should be kept of the deposit. All matters of importance which are not naturally included among those recorded on the topographical map or in the sample book are taken care of in the diary. Such matters as the date when work started on a test pit, when and to what extent a certain pit caved, etc., should be recorded in the diary.

NUMBERING OF SAMPLES.

Each sample is given a different number, irrespective of its location, and by this number the sample is identified at all times. When the sample is taken the number is marked on the map at the proper location from which the sample was taken. The number is also marked on a page in the sample book and on the detachable part of the page or tag of the sample book, if paper tags from the sample book are used. When the sample has been cut down to the desired size it is put into a sample sack or container, together with the tag bearing its number.

TAGS.

Only one tag is put into each sack with each sample. The tags used for this purpose are made either of paper, soft wood, or metal. Paper tags are usually used except when the samples are very wet. These are usually the detachable part of the page referred to in connection with the sample book, but can also be any piece of paper with the proper number written on it. These are rolled up tight in the form of a lead pencil and have their ends well crimped. This is

THIS TAG IS PUT IN SACK WITH SAMPLE

THIS PART REMAINS IN SAMPLE BOOK		TAG												
NAME OF DEPOSIT _____		SAMPLE NO. _____												
HOLE NO. _____														
KIND & CONDITION OF DIRT _____														
WEIGHT OF DIRT PER CU. YD. _____														
ASSAYS														
<table border="1"> <thead> <tr> <th colspan="2">GOLD.</th> <th colspan="2">METALS</th> </tr> <tr> <th>OUNCES PER CU. YD.</th> <th>VALUE PER CU. YD.</th> <th></th> <th></th> </tr> </thead> <tbody> <tr> <td> </td> <td> </td> <td> </td> <td> </td> </tr> </tbody> </table>		GOLD.		METALS		OUNCES PER CU. YD.	VALUE PER CU. YD.							REMARKS
GOLD.		METALS												
OUNCES PER CU. YD.	VALUE PER CU. YD.													

BLANK PAGE FOR A SAMPLE BOOK

done so that they will not unroll and get soiled, thus keeping the writing legible

Metallic tags having the number stamped on them are sometimes put into the sacks with the sample instead of the paper tags. Soft wooden tags with the numbers written on them with a hard lead pencil are also convenient. A hard pencil is recommended for writing the numbers on the wooden tags because it will cut into the wood and even if the lead is rubbed off the indentation will be left. This kind of tag is very useful with wet samples.

Where any other tag is used instead of the detachable tag of the sample book, all the information in regard to the sample should be recorded in the sample book in the same manner as was explained above.

SAMPLE SACKS.

Only new sample sacks should be used. Used sacks may contain values from the former samples which they have held, which values may get mixed with the sample, thus enriching or salting it. It is poor business to spend a large sum of money on a collection of fragments from a deposit, in obtaining the sample, testing, shipping, and other charges, if the collection is not a true sample of the deposit. New sacks cost only a few cents each and should always be used. If tin containers are used they must be thoroughly washed and cleansed before the sample is put into them.

SAMPLING PLACERS BY THE USE OF TEST PITS.

One of the common methods used for sampling placers is in the use of test pits. The method of procedure is the same whether the hole is a shaft, pit, drift, raise, or other form of excavation. The one point to be kept in mind is that *all* of the material excavated from the hole decided upon is the sample.

Test pits can be used to advantage where the ground is stable enough to stand up well, where the deposit is not too deep or where water does not interfere too much.

The sample from a test pit is considered by many engineers to be better, in some respects, than the samples taken from drill holes. This is based on several assumptions;

- (1) There is not the tendency for the values to concentrate in the lower level or bottom of the pit if the work is properly performed.
- (2) Sectional samples or samples for any particular depth at a given point can easily be taken.
- (3) The bulk of the sample from a test pit is much greater than that from a drill hole. For this reason, if small additions of values take place they will not affect the final result to so great an extent.

(4) In the test pit it is possible to see clearly the formations, and thus a better judgment of the deposit can be formed.

LOCATION AND NUMBER OF TEST PITS.

When test pits are used, great care and judgment should be exercised in locating the pits so as to get a fair final sample. Usually one pit for each two or three acres is sufficient. This is the number which was found ample in the sampling of several placers, but experience and judgment alone can decide this exceedingly important point for any particular placer deposit. As a general rule, the richer the deposit, the more pits are necessary. Also the greater number of pits are needed where the depth of the deposit is the greatest, as this represents the greater part of the tonnage. The sides or upper edges of the deposit should not be overlooked as these serve as indications as to whether the placer becomes richer or poorer as one works toward the higher benches.

FORM OF PIT.

The pits are usually rectangular in form, about three feet wide, and long enough so that a man can work to advantage. If the excavation is in the form of a drift, it must, of course, be high enough to work in comfortably. The sides should be as nearly perpendicular as possible. If the ground caves, it is necessary to timber it. If this happens, much care must be taken that none of the material outside of the section of the pit decided upon is included in the sample.

CAREFULNESS IN THE HANDLING OF THE SAMPLE.

The greatest care must be taken in handling the material. This is especially true after it has been taken out of the excavation. The safe way is to shovel or dump it directly onto a tight platform. If a platform is not available, a large sheet of steel or a large piece of thick canvas will answer the purpose. This is done so that no foreign material will get mixed with the sample. Since the bulk of the sample is usually much greater than is needed for the tests to be run (50 lbs. is usually more than is needed for panning and assaying), and too much to be handled conveniently, the next step is to cut or quarter it down to the size desired.

METHODS USED TO CUT DOWN THE SAMPLE.

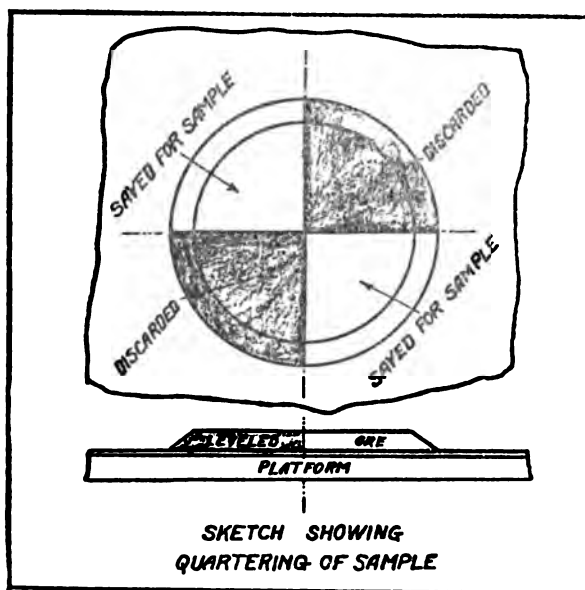
Where mechanical quartering machines are not available and the sample is over 800 pounds, all of the following methods can be used, in their order, to advantage in quartering down the sample. When the sample is less than 500 pounds and over 100 pounds, the Cornish method of quartering can be used. When the sample is less than 100 pound, the method using canvas or oilcloth is good.

**CUTTING DOWN SAMPLE WHICH WEIGHS OVER 800 POUNDS.
SHOVEL METHOD.**

The first of the cutting down to about 500 pounds can be done by the use of shovels. In this method every second shovelful is passed to another platform or a different part of the same platform, which has been well cleansed. The odd ones are discarded. This operation cuts the sample in half. If it is still much too large (over 800 pounds) the above operation is repeated until the sample gets to between 300 pounds and 800 pounds. After it is cut down to this size (about 500 pounds) it is better practice to use the Cornish or Coning method down to about 100 pounds.

CORNISH OR CONING METHOD OF QUARTERING.

When the sample is not much over 700 pounds this method is used conveniently. The last heap of material from the preceding work of cutting down is leveled to a circular form not over four inches deep,

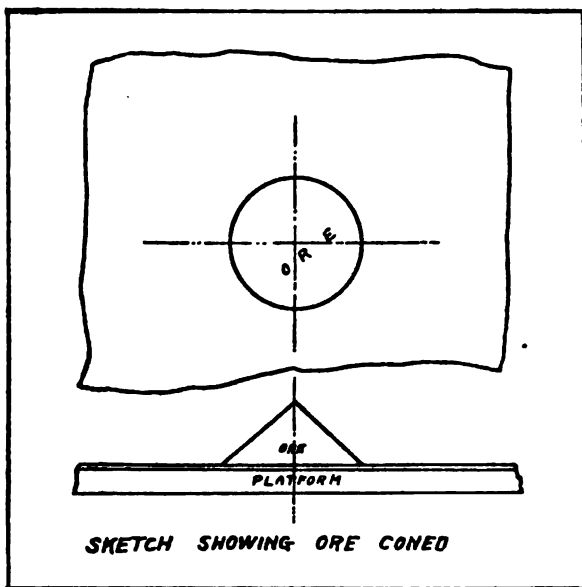


by the use of a hoe, flat-nosed shovel, or a similar tool. The next step is to cone it, which is done in the following manner: From the outside of this leveled heap, at points equally distant from each other, equal amounts are shoveled up and allowed to fall onto the center of the

leveled heap in such a manner that the material is evenly distributed on all sides of the cone which is formed. In this way only a portion of the heap is shoveled up is passing once around it, thus making an even distribution of the values.

After all of the material outside of the cone is piled up in this manner onto the cone, the material is removed to a different platform or a clean part of the same platform and leveled and coned again. This process is repeated until the material has been thoroughly mixed. When this has been accomplished it is then leveled again to a circular form not over four inches deep, and divided into equal quarters by cutting it along two diameters at right angles to each other. The two opposite quarters are discarded.

Much care must be taken in doing this work, as well as to clean thoroughly the parts of the platform where the discarded metal has been in order to prevent salting. If the sample is still too large, more than 200 lbs., the two quarters which were left from the preceding operation are removed to a clean part of the platform where it is leveled, coned, and leveled again to a circular form and divided as before, the two quarters being again discarded. This operation is repeated until the sample reaches about 100 pounds, when the following method should be used:



QUARTERING BY USE OF CANVAS OR TABLE OILCLOTH.

The final sample from the preceding work is shoveled onto a square piece of table oilcloth or canvas about 6 feet by 6 feet. After this is done the two opposite corners of the oilcloth are taken, one in each hand. While one of the corners is slowly lowered, the other is raised at the same rate, the lower part of the oilcloth always resting on the ground or platform. This motion rolls and mixes the sample. After this is well performed the first two corners are allowed to fall flat,

while the other two are taken in the same way. The sample is again rolled and mixed, but in the opposite direction to the first mixing. This is repeated several times until the sample is thoroughly mixed.

When this has been accomplished satisfactorily the canvas is spread out flat and the sample is leveled to a circular form as described before in the coning method. It is then divided into equal quarters by cutting it along two diameters at right angles to each other, as illustrated in figure (2). The two opposite quarters are discarded as in the coning method and the space where they were is thoroughly cleansed. If what remains is still too large the entire operation is repeated until the sample reaches the desired size. After thoroughly mixing it again the sample is put into a sack with the tag bearing its number for identifying it. It is then ready to be tested.

SECTIONAL SAMPLES.

These are samples taken at a given depth to indicate how the values run at that particular depth. They are usually taken from a section which has the same width completely around the pit or drift. When it is necessary to timber, these samples must be taken before the timber is put in place.

In the sample book record the number of the sample, the date when taken, the number of the pit, and all other data bearing on the sample. Measure down to the top of the section to be sampled from a fixed known elevation, such as the permanent ground level or a nail or stake solidly driven in at a definite elevation. Record this measurement in the sample book, together with the width of the section to be sampled.

The sample is the material which is picked off evenly from every part of this section. A sample pick, drill, or similar tool can be used. A box or other receptacle is held below so that all the material will be caught as it is broken off. A powder box answers this purpose very well. It is well to spread a piece of canvas on the ground below the place from which the sample is taken so as to catch any pieces that may not fall into the box. If the sample is too large it can be cut down, by one of the methods explained before, to the desired size. After being thoroughly mixed, the sample is put into the sack with the tag bearing the proper number, and is then ready to be tested.

DRILL SAMPLING.

Sampling by drilling is done either by the use of an augur drill, or by a churn drill outfit.

AUGUR DRILL METHOD.

The augur drill is a tool similar to that used in drilling post holes. The hole is made by the augur as it is turned, the material raised on the blades of the augur being the sample. It can only be used to advantage in soft ground which does not cave too badly, and only to a limited depth. The caving may be overcome by casing the hole.

Sampling by this method, where it can be used, is by far the cheapest and quickest of any method. It has the disadvantage, in some cases, of having the values concentrate at the bottom of the hole, from which it is next to impossible to extract them, thus tending to give an unfair sample.

The same care and experience in locating the holes to be drilled must be used in this method as in the location of the test pits. The records for sampling by this method are kept in the same manner as for test pits, and the same method for cutting down the samples can be used. After they have been cut down to the desired size they are well mixed, put into a sack with the tag bearing the proper number, and are ready to be tested. The testing of the samples and the method of calculation used will be treated later.

SAMPLING PLACERS BY THE USE OF A CHURN DRILL OUTFIT.

This is one of the very few methods which can be used to advantage when the deposit is deep, where the ground caves and where water interferes. For deep holes the cost per foot of hole drilled is low and the work usually progresses very rapidly.

There is the disadvantage of the possible concentration of the values in the bottom of the hole, from which it is difficult to extract them. The values from around the sides of the hole may also be washed down into the sample and salt it. Sectional samples by this method are not considered to be very satisfactory. An expensive outfit is needed to do the work by this method, and unless much drilling is to be done it is found better to let the job to a reliable churn drill contractor who will furnish the rig, casing, and other supplies needed, as well as the skilled operators who are absolutely essential for doing the work satisfactorily. Where the ground caves or water interferes it is necessary to case the hole.

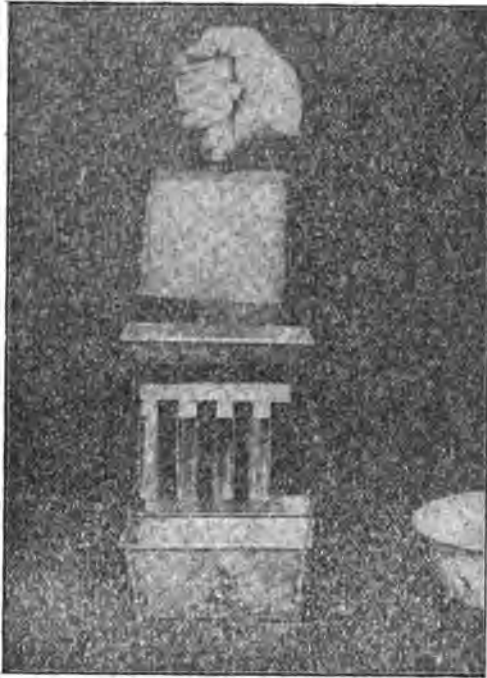
LOCATION OF THE HOLES TO BE DRILLED.

The same care and judgment should be taken in the locating of the points where the holes are to be drilled as is necessary in the location of test pits, and the same matters should be borne in mind when doing this work.

The same general method of procedure in mapping the deposit, taking and numbering the samples, and the care necessary in handling them, must be used for the churn drill work.

The material taken from the hole is usually crushed by the operation of the drill bit to a size smaller than a walnut. If, as in most

cases, the sample is much larger than is needed for testing, it can be cut down to the desired size by using the methods heretofore described. The sample from the churn drill hole seldom contains pieces much larger than a walnut and can be cut down very rapidly and accurately by the use of a Jones Sampler. This is an inexpensive apparatus which stands rough handling and is not very bulky. If the work is properly done, the final cut down sample is absolutely accurate and for this reason this machine can be used to advantage, providing the pieces in the sampler

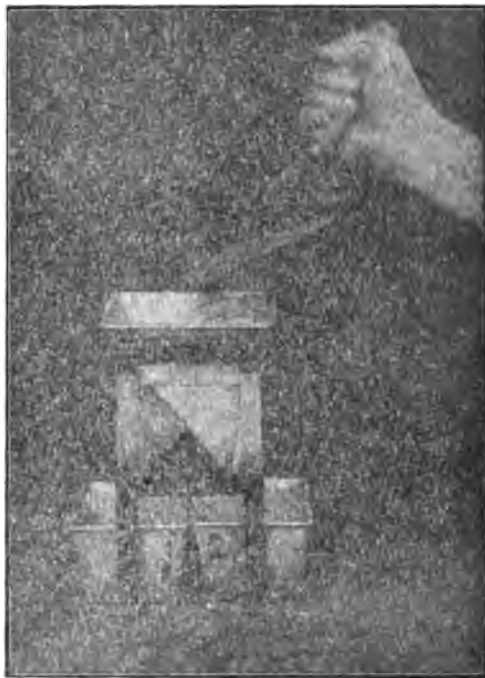


are not over one-half as big as the width of the slot in the sampler which is used. It is sometimes advisable to use one large sized sampler in the first part of the cutting down work, cutting down to the final size by using a smaller sampler, the slots of which are narrower than than in the first.

JONES SAMPLER.

On top, the Jones Sampler has a row of horizontal slots, all of which have the same length and width. From each one of the slots runs a chute, every second chute running in the same direction; that is, the outlet from the first chute and slot is opposite to the outlet from the second chute and slot. The material is shoveled slowly from a flat-nosed shovel or scoop transversely onto these slots, much

care being taken that they do not clog, the material distributed evenly by moving the shovel back and forth from one side to the other of the machine. The end of the shovel should be held about one inch above the slots of the sampler and in this way equal amounts of the sample will fall into each slot and run down and out of the chute under it. A pan is placed under each row of chutes to catch the material. If the work is properly done, exactly one-half of the material will be caught in each of the pans, and each pan will contain the same values. One operation of the sampler cuts the sample in half. The material in one of the pans is saved for the sample, while that in the other is thrown away. If the sample is still too large, the above operation is repeated until it reaches the desired size. It is then put into its sack with the tag bearing the proper number, tied up, and is ready to be



tested.

TESTING THE SAMPLES—PURPOSES OF THE TESTING.

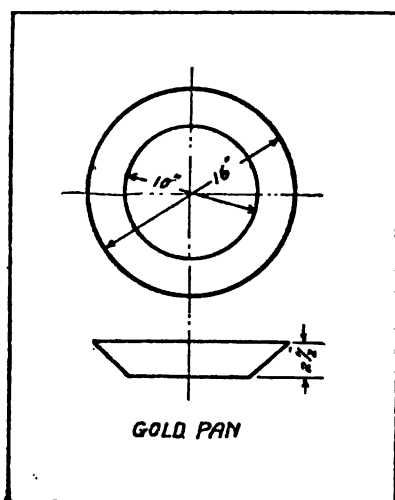
The amounts of valuable mineral present and recoverable are the most important points to be decided from the test. Supplementary to this are several other important matters which should be taken into consideration, such as the form in which gold occurs, whether fine, coarse, or flaky; whether clay is present, and to what extent, and all other points which will determine whether or not the deposit can be worked at a profit.

METHODS OF TESTING.

Samples from gold placers are tested by panning or by the use of the dry washer or concentrator, or by both. Only those deposits

where the dry washer can be used for working the deposit should be tested by the dry washer. These placers are only found in the deserts, where water for washing the ground is out of the question and where the ground is absolutely dry and free from clay. In all other placers the samples are usually tested by panning. After the panning tests prove satisfactory, tests on a large scale are usually made by using the method decided upon for doing the work.

For testing samples by panning the most important thing is a thoroughly experienced panner. The tools needed are good gold pans,



a measuring box, small pans, glass vials, a good pair of balances, and tags. The pans used are the regulation gold pans made from sheet iron and must be absolutely free from grease and rust. They are usually 16 inches in diameter on top, 10 inches in diameter on the bottom, and 2½ inches high.

When the value of the gold obtained from the panning of one or more boxes of the dirt is known, it is an easy matter to calculate the value for a cubic foot or cubic yard of the dirt. The following example will illustrate this point:

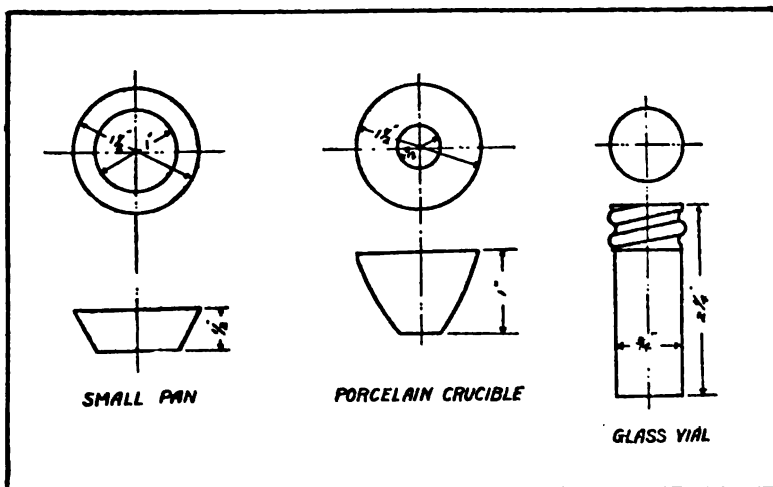
Suppose four boxes of dirt were panned, and from them were recovered \$0.02 of gold. (Gold figured at \$20 per ounce Troy.) Since there are 8 of the 6"x6"x6" boxes in one cubic foot, and there are 27 cubic feet in one cubic yard, the calculation for this case is the following:

$$\$0.02 \times 2 = \$0.04, \text{ the value per cu. ft.}$$

$$\$0.04 \times 27 = \$1.08, \text{ the value per cu. yd.}$$

Small pressed steel pans of about one and one-half inches in diameter on top, and one inch in diameter on the bottom, and one-half inch deep, made in the same shape as the gold pans, are very convenient for holding and drying the values after they have been concentrated in the gold pans. Small porcelain crucibles are also used for this purpose. Small stoppered glass vials are sometimes used, especially if the samples are to be transported to a distant place to be assayed and weighed.

The box used for measuring the dirt to be panned can be of any convenient size, the cubical contents of which are known. A very convenient size is a box whose inside dimensions are exactly 6 inches long, 6 inches wide, and 6 inches deep. This box, when filled smooth to the top, holds exactly one-eighth of a cubic foot, or one-two hundred and sixteenth part of a cubic yard.



A good set of balances with a standardized set of weights should be used for the weighing of the values recovered. It would be poor business to do all of the work well and then use an inaccurate set of balances to do this very important part of the work.

For identification purposes a tag must accompany each sample, and the concentrate from it. This tag always bears the number of the original sample from which it was taken and all additional data which applies to this part of the sample only, such as the number of boxes of dirt washed to obtain the concentrate, the method used in the testing, to obtain the sample, the condition and kind of the dirt, etc., etc.

WEIGHING OF THE SAMPLE.

After the sample is brought to the place where the testing is to be done, the measuring box is filled and weighed. The weight of the sample is the total weight minus the weight of the empty box or receptacle. Since the cubical content of the box is known, the weight of a cubic yard of the dirt can be calculated. This is needed in order to make the calculations from the gold per ton to the gold per cubic yard.

FIRE ASSAY OF PART OF THE SAMPLE.

At this point in the work a part of the original sample should be taken to be assayed by the fire method. This will give the exact mineral content of the sample, and from the value obtained the mineral present in the deposit can be calculated. The assay values are only used for calculations for the gold present, and are always given by assayers in ounces Troy—per ton (2000 pounds avoirdupois) of dirt, so that from this it is necessary to calculate the value per cubic yard of dirt.

PANNING.

One or more boxes of the dirt, as desired, are then dumped into a gold pan and panned, the amount of dirt from each sample which is panned to get each concentrate being recorded on its tag and in the sample book. This operation needs no explanation as those connected with placer mining are usually expert at this class of work. After all of the dirt is washed out and only the concentrates remain, there are two common methods of procedure for separating and collecting the gold from the black sand and other impurities which are always found in placers. One of the methods is to assay the concentrates by the fire method and weigh the resulting gold bead. This gives the amount of gold recovered from the amount of dirt panned, and the gold recoverable from a cubic yard can be easily calculated. This method is perhaps the quickest, most accurate, and cheapest of any. The other method is to add mercury or quicksilver to the concentrates and amalgamate the gold. The amalgam is then retorted. This operation removes the quicksilver and leaves the gold in the retort, from which it can be removed and weighed.

The values in this operation are for the gold recoverable from a cubic yard of the dirt, and are only used in the calculations for the gold recoverable. The practice of washing the black sand and other impurities in a horn is not recommended, as much of the value may be washed away and lost, thus giving an unfair result.

TESTING WITH THE DRY WASHER.

The same general method of procedure can be followed as above outlined, if the sample is to be tested by the dry washer in the actual testing. A sample of at least 100 pounds is needed.

From the above operations the value of the gold present and recoverable per cubic yard is determined for each sample. It is then necessary to determine the gold present and recoverable from the

entire deposit. This work requires the services of a man experienced in engineering calculations.

CALCULATIONS FOR THE VALUES OF THE DEPOSIT.

Two separate and distinct calculations should be made to determine these. One is for the gold actually present, and for this calculation the value as determined from the fire assay of the original sample before it was panned is used. The other calculation is for the gold recoverable, and in this calculation the values obtained after the samples have been panned are used.

GOLD PRESENT.

The gold present in a deposit is found in the following manner: The cubical volume of each section is calculated from the cross sections which are taken from the topographical map. The depths used are as found in the test pits, except they should be adjusted as determined by the contours of the bedrock.

The gold present for a section is the product of the cubical contents of the section multiplied by the gold value per cubic yard, as determined by the fire assay of the original sample taken from the test pit for that section before the sample was panned. The gold present in the entire deposit is the sum of gold present in all the sections.

GOLD RECOVERABLE.

The same method as described above is used for determining the cubical contents of each section. The gold recoverable for a section is the product of the cubical contents of the section multiplied by the gold value per cubic yard, as determined from the results obtained from the panning or dry washer tests.

After the above results have been obtained it is usually desirable to make a valuation of the deposit.

VALUATION.

The purpose of the valuation of a placer deposit is to find out the net profit obtainable after all charges have been deducted.

As there are no two placer deposits exactly alike, and as all differ so much from each other, it is impossible to give anything but a few suggestions as to what has to be taken into consideration in this matter. In addition to the estimation of the gold recoverable by the process of extraction decided upon, management, climate, labor, power, fuel, water, transportation, equipment, food supplies, interest

on investment, depreciation, government regulation, kind of government, etc., etc., are some of the many items which are important and must be taken into consideration in the calculations for making the valuation of any placer deposit. For the above reasons it seems advisable to have a thoroughly competent, reliable and experienced engineer supervise and be made responsible for the valuation of a placer deposit. The work will not only be correctly done, but the report on the deposit as submitted by the engineer will be accepted by everybody as authoritative.

University of Arizona Bulletin

BULLETIN No. 52

EDUCATIONAL SERIES No. 1

PROCEEDINGS OF THE Arizona State Teachers' Association

TWENTY-FOURTH ANNUAL SESSION
AT TUCSON, ARIZONA,
APRIL 12-13-14, 1916

PART I
PROGRAM, MINUTES, ATTENDANCE



PUBLISHED BY THE
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EDUCATIONAL BULLETIN

EDUCATIONAL SERIES No. 1

JANUARY, 1917

PROGRAM

Meetings held in the buildings of the University of Arizona.

WEDNESDAY, 9 A. M.

General Assembly, in Auditorium. President R. B. von KleinSmid presiding.

10 A. M.—CONFERENCES

For High School Teachers—Chairman, Principal F. W. Hart, Prescott High School.

Teaching the High School Student How to Study.....
.....Superintendent G. O. Cornelius, Winslow

What May Be Expected of the High School.....
.....Principal R. T. Cook, Phoenix High School

What May the High School Expect of the Grades.....
.....Superintendent J. A. Davis, Clifton

For Grammar Grade Teachers—Chairman, Principal E. C. Bunch, Benson Public Schools.

Is Our Teaching of Language a Failure.....

Miss Allegra Frazier, Teacher of English, Tucson High School

Tests and Examinations.....

.....Assistant Superintendent C. W. Randall, Phoenix

Grading of the Pupil—General Discussion.

For Primary Teachers—Chairman, Superintendent C. A. Goggin, Morenci.

Teaching the Non-English Speaking Child.....

.....Miss Helen Roberts, Teacher in Tempe Normal School

Methods of Teaching Primary Reading.....

.....Miss Nellie M. Pollock, Teacher in Phoenix Schools

WEDNESDAY, 1:30 P. M.—GENERAL "ARIZONA SESSION"

Topic, "Educational Team Work in and for Arizona." President R. B. von KleinSmid presiding.

Rural Schools. .County Superintendent C. Louise Boehringer, Yuma

Elementary City Schools.....

.....Mrs. Anne Rogers, Principal of Roskrige School, Tucson

High Schools.....Principal F. W. Hart, Prescott High School
 Normal Schools..President A. J. Matthews, Tempe Normal School
 The University.....
President R. B. von KleinSmid, University of Arizona
 The State Administration.....State Superintendent C. O. Case

WEDNESDAY EVENING—GENERAL SESSION

Song Contests between High Schools.
 President's Address.....President R. B. von KleinSmid
 Reception at President's Residence.

THURSDAY, 9:00 A. M.—CONFERENCES

For Rural School Teachers—Chairman, County Superintendent J. W. Brown, St. Johns.

Interesting the Community.....
 Mrs. Ella P. Seward, Teacher in Madison School, Maricopa County
 Boys' and Girls' Clubs.....
L. S. Parke, State Club Agent, University of Arizona
 Need the Rural School Be Isolated.....
Professor I. Colodny, University of Arizona

For Graded School Teachers—Chairman, Superintendent G. C. Sherwood, Mesa.

State Course of Study; Its Uses and Abuses.....
Superintendent Homer Davis, Glendale
Superintendent W. E. Lutz, Douglas
 How the University Agricultural Service May Help the Public School.....S. F. Morse, Superintendent of Agricultural Extension Department, University of Arizona.

For High School Teachers—Chairman, Principal F. S. Randle, Globe High School.

Interscholastic Relations.....
Principal E. A. Row, Tempe High School
 The High School Library.....
 ..Miss E. Luttrell, Librarian, University of Arizona Library

For School Officials—Chairman, Superintendent Oscar Mullen, Tempe.

Vitalizing the County Institute—General Discussion

THURSDAY, 1:30 P. M.—GENERAL SESSION, "SURVEY SESSION"

Vice-President C. F. Philbrook presiding.

The Meaning of a Survey....Superintendent W. P. Bland, Globe

Some Typical Surveys..Professor A. O. Neal, University of Arizona

Who Shall Do the Surveying.....

.....Superintendent C. F. Philbrook, Bisbee

Who Shall Be Surveyed.....Superintendent J. D. Loper, Phoenix

How It May Be Started.....

.....Professor I. D. Payne, Tempe Normal School

THURSDAY EVENING—GENERAL SESSION

President R. B. von KleinSmid presiding.

Oratorical Contest between High Schools.

Address, "Glimpses of Evolutionary History".....

Director D. T. MacDougal, Carnegie Desert Laboratory, Tucson

FRIDAY, 9 A. M.—GENERAL SESSION

President R. B. von KleinSmid presiding.

Conservation.....Dr. Mary L. Neff

Standards and Tests in Education (Omitted for want of time) ..

.....Professor H. H. Foster, University of Arizona

Exhibition of Work of State Deaf School.

Business Session of the Association.

Noon—Luncheon as guests of the University of Arizona.

Afternoon—Visitation of exhibits in the University, followed by trip to the San Xavier Mission.

FRIDAY EVENING—GENERAL SESSION

Lecture, "Prehistoric Arizona".....

.....Professor Byron Cummings, University of Arizona

Banquet for visiting teachers as guests of the University Club of Tucson.

NOTE: Because of the extemporaneous character of many of the addresses of the various meetings, it was found impossible to publish all of the addresses. In many cases the speaker provided merely a summary of the address, which is published as thus provided.

MINUTES OF THE 24TH ANNUAL SESSION OF THE
ARIZONA STATE TEACHERS' ASSOCIATION,
APRIL 12, 13, 14, 1916.

The Arizona State Teachers' Association met for the 24th annual session in the auditorium of the University of Arizona at Tucson. President R. B. von KleinSmid called the association to order at 9:30 o'clock Wednesday morning. Miss Lois Whisler of Tucson rendered two piano solos. The minutes of the 23rd annual session were read by the secretary. Two vocal solos were then rendered by Miss Salter.

President von KleinSmid gave a brief address of welcome, urging all members of the association to feel at home and to make their visit in Tucson a pleasant one. He then announced that Professor Otis was chairman on accommodations and if any teachers were without rooms they should see him in Room 102 of Agricultural Hall. This room was also designated as a registration room, where members of the association were asked to pay their dues of \$1.00. The chairman announced that the university trustees had offered to print the minutes of this session together with as many papers as could be secured, as a part of the extension work of the university.

The association then adjourned to meet for conferences in various rooms of the agricultural building with Principal Hart of Prescott as chairman of the high school teachers' section, Principal Bunch of Benson as chairman of the grammar grades teachers' section, Principal Goggin of Morenci as chairman of the primary teachers' section, and Professor A. O. Neal of the University as chairman of the school officials' section.

The afternoon session was called to order by President von KleinSmid at 1:30. Mrs. Douglass of the music department of the University rendered two piano solos. The chairman repeated announcements of the morning session regarding the registration, certification of railroad tickets, and meals to be served in the university dining room at twenty-five cents to members of the association.

Then Miss Louise Boehringer spoke on educational team work in and for Arizona through the rural schools. She said, in part, that team work was needed rather than individual star playing. The work of the rural schools was to point the students upward, and the high schools were to reach downward and help the boys and girls up. There is great need of correlating the work of the home and the school through the parent-teachers' meetings and also correlating rural schools with the city schools and high schools through various

contests. The speaker suggested that visiting days to the university would be of great help to pupils of the rural schools. Teachers of the rural schools should be required to visit the higher institutions and to inform the pupils of the work of these higher institutions. The field of school work is so great that there is no need of jealousy among the workers, but rather a place in honor of preferring one another.

Mrs. Anne Rogers of Tucson spoke on team work in and for Arizona through the elementary city schools. The speaker said, in part, that she had been in school work of Tucson for 16 years and that her remarks would be entirely from her own experience. She remembered the time when classes of the same grade in the same building knew nothing of the work of the others, but were working entirely apart. This had been changed to a correlation of work to the extent that classes of the same grade in the various buildings of the city are today doing practically the same work. Team work in the city schools is essential to the success of the teacher, for teachers must be able to see beyond their own rooms. There should be a definite correlation of expenditure of time for all the classes of the various grades. The speaker insisted on the absence of all fads and frills in school work and urged the co-operation of teachers with intelligent parents. The teacher should be given absolute freedom in her own room, but should have the right attitude toward the work and the pupils of her co-workers and toward her employers.

Two vocal solos were then rendered by Miss Post of the University of Arizona.

F. W. Hart, principal of the Prescott high school, spoke on educational team work in and for Arizona in the high schools. He said, in part, that high schools are responsible and accountable for the attendance of their students in college. Grammar grade teachers must urge their pupils to go on through the high schools, and high school teachers must urge their pupils to continue work in the normal schools and universities. The best way to reach the students is through individual talks about their pursuance of high school and normal school work. The speaker then entered more fully into a discussion of a reference library for high schools.

President A. J. Matthews of the Tempe Normal spoke on educational team work in and for Arizona through the normal schools. He said, in part, that the normal school called for special lines of work, that especially of a teaching education. The normal schools of Arizona are typical for all the normal schools of the country, and admission to the normal schools is through graduation from the high

school or through graduation from the grammar grades requiring a period of five years' work. President Matthews called attention to the weakness in our high school work as that of the inability on the part of high school students to read and gather thought from a printed page. Therefore the normal schools had to give work in review, which was sometimes humiliating to the students; but here, as elsewhere, there is great need of team work.

Doctor R. B. von KleinSmid spoke on educational team work in and for Arizona through the university. The departments of the university are willing to furnish information about the work through bulletins and circulars sent out "gratis." Some people imagine a great gulf between the public schools of the state and the university. This should not be so; for the education of the individual must be a unit and since all the institutions of learning are under the same auspices, the system should be one of uniform action. The fact that high schools are specializing in certain lines has been detrimental to much of university work. The course of literature in the university has been made difficult because students of the high school are not taught to appreciate literature. They are too often required to do too much analysis. History is too often taught as a record of events and of dates, while it should be a record of man's will, and, as such, every boy and girl has a part in the making of history. The university should be reaching down and lifting up those who have been pointed upward by the high schools of our country. The greatest aim of all education should be to make leaders and all our public institutions of learning should point out qualities of leadership.

At 7 o'clock on Wednesday evening occurred the song contest of the various high schools of the state in the auditorium. At the conclusion of the contest President von KleinSmid gave his annual address to the state association on the theme, "Unless There Be a Vision, the People Perish." The speaker pointed out very emphatically the fact that leaders in the educational field from the time of Froebel and Pestalozzi have shown the way to successful educational methods.

A most delightful reception was tendered the visiting teachers by Doctor and Mrs. von KleinSmid at their pleasant home on the university campus.

On Thursday morning at 9 o'clock the association met for departmental conferences in various rooms of the agricultural building. County Superintendent Brown of Apache presided over the rural schools section; Superintendent Mullen of Tempe presided over the school officials section; Superintendent Sherwood of Mesa pre-

sided over the grammar grades section; and Principal Randle of Globe presided over the high schools section. Interesting papers were read in all of these sections.

At 1:30 p. m. the association convened for a general session in the auditorium. President von KleinSmid called the meeting to order and invited all vice-presidents, consisting of seven county superintendents present, to be seated on the platform. Then he called for members of the nominating committee from the various counties to answer to roll call of counties. The following constituted that committee: Superintendent Brown of Apache, Miss Lintz of Cochise, Mr. Latham of Coconino, Mr. Randle of Gila, Mr. R. P. Jones of Graham, Superintendent Goggin of Greenlee, Superintendent Mullen of Maricopa, Professor A. O. Neal of Pima, Mr. Sullivan of Santa Cruz, and Principal F. W. Hart of Yavapai.

Mrs. R. G. Fisher of Tucson rendered "April Morn," by Patton, as a vocal solo. The chair then called upon the Reverend Mr. Sproles of Tucson to speak the invocation. The chair appointed the following auditing committee: Superintendent Goggin of Morenci, Professor I. D. Payne of Tempe, and Principal F. W. Hart of Prescott. He also appointed the following committee on resolutions: Superintendent G. E. Cornelius of Winslow, Superintendent R. G. Stephenson of Jerome, Principal F. S. Randle of Globe, and Miss Sarah M. Whitfield of Phoenix.

State Superintendent C. O. Case had been unable to appear on the program on Wednesday afternoon, so he was called upon to speak on educational team work in and for Arizona through the state administration. In his paper this speaker advocated standardization of schools, elimination of illiteracy, school survey, revision of the course of study, the teaching of lessons of thrift, reading circle work, and more efficient school legislation.

The regular program for the afternoon consisted of a discussion of school survey. Professor Neal, chairman of the state survey committee spoke of "Some Typical Surveys." He said, in part, that the educational bureau at Washington, D. C., through the Honorable C. P. Claxton, has promised to survey the schools of Arizona next fall. The survey of schools is not a new idea, for commissions have been appointed in various states to make such surveys. The first city to make a school survey was that of Boise, Idaho, in 1910. Since that time typical school surveys have been made in the state of Ohio and the state of Vermont, and since then twenty-eight states have been subjected to such surveys. In this survey it was found that the state of Washington ranked first, and Indiana, which has

been looked upon as the leader in education, ranked twelfth. President von KleinSmid reported that the survey commission has promised to investigate the University of Arizona first.

Superintendent C. F. Philbrook of Bisbee discussed the question as to "Who Shall Do the Surveying." He pointed out that the teachers themselves could not survey. Self-inspection, while good at times, is not desirable in this survey. The proper survey should consist in finding out mistakes, pointing them out, facing them, and making improvements. The man that is trained for such work is the one that should make this inspection. He should be a man of practical experience and should be assisted by local talent. Professor Philbrook offered to be first in the state of Arizona to be inspected by the national commission.

A vocal solo was rendered by Mr. E. Kinney Miller, secretary of the Tucson Y. M. C. A.

Superintendent J. D. Loper of Phoenix spoke on "Who Shall Be Surveyed." The schools together with the taxpayers and the legislators should be surveyed. Mr. Loper said that after a thorough investigation it would be found that we are not spending enough money for our schools instead of the general accusation that we are spending too much money. The survey of Maricopa county is sure to be a very helpful one. It is Professor Loper's opinion that everything connected with our school system should be thoroughly surveyed.

Professor I. D. Payne of the Tempe Normal spoke briefly on the question, "How May a Survey Be Started?" He said, in part, that the hopeful condition of a year ago for an appropriation by the state legislature had failed and now we should have to depend upon local county surveys, financing them as best possible. He said that we should greet with much enthusiasm the investigation to be made from the Bureau of Education in Washington, D. C.

At 7 o'clock on Thursday evening occurred the oratorical contest of the various high schools of the state, which was won by Marcy Malcolm of Phoenix. This contest was followed at 8:45 by a lecture given by Doctor D. T. MacDougal on "Glimpses of Evolutionary History."

Friday morning the association was called to order by President von KleinSmid at 9:15. Miss Lois Whisler, a student of the university, rendered a piano solo entitled "A Summer Night," by De Bussy. The Reverend Mr. Van Valkenburgh of Tucson then spoke the invocation. Since Doctor von KleinSmid had a meeting of the

board of regents in the university office he called Treasurer C. F. Philbrook to the chair.

Professor Philbrook introduced Doctor Mary L. Neff of Phoenix, who spoke at length on the subject of "Conservation." The speaker said, in part, that we had considered the conservation of forests as well as that of animal life of great importance, but we were just coming to understand the value of conservation of the child. It is true that the superior child should be conserved by giving him special privileges; but greater attention must be paid to the subnormal child to prepare him for life. The Binet-Simon test applied in Philadelphia has shown a regular gradation of pupils with regard to their ability and their attainments as belonging to four classes: First, the select class in the private schools; second, the average class in the public schools; third, the sub-normal class in the disciplinary institutions; and fourth, the delinquent group. In a standardization of inmates of the Iowa and Kansas state penitentiaries it has been shown that but a small percentage of them are of normal mentality. There is at present no means of providing for deficient children in the state of Arizona and no way of looking after the feeble-minded. A person showing a mentality of an eleven-year-old child is capable of making a living on the farm. He can be floated; but he is not safe in city life. Feeble-mindedness is hereditary and something should be done to stop the increase of it.

Professor Griffin, superintendent of the Deaf and Dumb School, brought forward a class of six boys to give a demonstration of the work done in the institution. After a few introductory remarks he introduced Miss Bradley, the teacher of the children, who showed what the children had been learning and her method of instructing them.

At 11:20 the association convened for its business session. President von KleinSmid was again in the chair. The treasurer, C. F. Philbrook, reported that he had \$87.70 in the treasury aside from the money received as dues for membership, which at this session amounted to \$143, making a total in the treasury of \$230.70. The report was approved by the auditing committee. Superintendent G. E. Cornelius reported for the committee on resolutions. The report as changed and amended follows:

RESOLVED, That it be the sense of this convention that:

1. The state board of education do appoint permanent committees for the revision of the state course of study; a committee to be appointed for each subject; each committee to consist of a city super-

intendent, a normal school specialist in said subject, and a teacher of said subject.

2. The law committee be instructed to prepare a bill making the offices of the state and county superintendent appointive, not elective.

3. That the president of the State Educational Association be given the power of appointing a nominating committee consisting of one member from each county to hold office one year.

4. That the State Teachers' Association does approve the provisions made for the state survey.

5. That the state board of education be requested to publish the minutes of their proceedings for the information of teachers and citizens.

6. That it be the sense of this association that the \$500,000 common school levy shall be made permanent.

7. That the official organ of the Association be commended for its efforts in behalf of the teaching forces of the state.

RESOLVED, That a state committee on high school libraries be appointed whose duties shall be as follows:

1. To send out a questionnaire as to conditions affecting the high school libraries of the state and to tabulate results.

2. Based on this survey, to recommend standard equipment for three types of high schools; i. e. for the city having an enrollment of 800 or more; the town having an enrollment of 200 or more; the small rural school having an enrollment not exceeding 100 pupils.

3. To be prepared to give advice to schools applying for it.

4. To recommend a fixed annual appropriation for buying books.

5. To urge the need of training pupils in the use of books and libraries.

6. To organize a system of traveling libraries in the rural communities.

**A RESOLUTION RESPECTFULLY RECOMMENDING TO THE STATE BOARD
OF EDUCATION THE ESTABLISHMENT OF A PERMANENT
STATE EDUCATIONAL COUNCIL.**

WHEREAS, The educational interests of the state are unusually diversified and the chief educational centers widely separated;

WHEREAS, There is a great need of a better course of study—one more varied and flexible in order to meet the various special problems of each particular community;

WHEREAS, There is the constantly recurring necessity of adopting
*text books each year with its attendant uncertainty of what change
changes are to be made and the consequent unhappy discussion
dissensions as to what is the best adoption to make;

WHEREAS, There are legislative and constitutional changes needed, but there is no concerted plan to bring them about, nor any unified or definite agreement as to what shall be best or is most urgent;

AND WHEREAS, There is no definite educational policy, no adequate means of moulding and impressing public sentiment towards educative needs and conditions, or of promoting and maintaining the proper professional spirit and interest;

THEREFORE BE IT RESOLVED, That the state board of education is respectfully recommended to exercise its vested powers in appointing by any manner agreed upon a state educational council to be composed of not less than twenty nor more than thirty members who shall be so chosen as to represent all the varied educational interests in the widely scattered communities of the entire state, and whose duties shall be so defined as to enable it to assist in caring for the aforesaid conditions.

AND BE IT FURTHER RESOLVED, That a copy of this resolution shall be submitted to each member of the state board with our most respectful recommendations that this plan, together with general prescribed duties and powers of said council, be carried into effect as soon as convenient and by any means agreeable to them.

Upon motion by Superintendent C. F. Philbrook the committee on resolutions was made a permanent committee. Upon motion by A. O. Neal this committee is to work out its resolutions during the year, have them printed and presented to the association at the opening of our next session.

President von KleinSmid then presented the report of the law committee and stated that it was no more than a memorandum of what had been presented to the state legislature at its last session. Professor Homer Davis moved to refer this report without reading it to the incoming law committee.

The committee appointed on Wednesday by the school officials section of the association presented a report, which was referred to the resolutions committee upon motion by Professor I. D. Payne.

The president called for the report of the nominating committee. Chairman Goggin of Morenci reported the following names:

For president of the association—F. W. Hart of Prescott.

For secretary of the association—Professor I. Colodny of Tucson.

For treasurer of the association—Miss Leonora Francis of Cocino.

The chair then called for nominations from the floor and the following persons were nominated:

For president of the association—Superintendent Madden of Nogales.

For secretary of the association—Miss Sarah M. Whitfield of Phoenix.

For treasurer of the association—Superintendent C. F. Philbrook of Bisbee.

A vote by ballot resulted in the election of Superintendent Madden for president, Miss Sarah M. Whitfield for secretary, and Superintendent Philbrook for treasurer.

The retiring president, Doctor von KleinSmid, took occasion to express his delight at having had so many of the teachers of the state to attend the association and to be guests of the university. Superintendent Baker of Prescott recommended to the executive committee that the meeting next year should again be held at the university at Tucson during University Week, and Doctor von KleinSmid extended a cordial invitation to do so. He then declared the 24th Annual Teachers' Association of Arizona adjourned.

A noon luncheon was served by the University of Arizona in Arizona Hall to all the visiting teachers. In the afternoon many of the guests were taken out to the San Xavier Mission and at 7:30 that evening Professor Cummings of the university gave a lecture to an appreciative audience on the great archaeological wonders of Northern Arizona.

The men teachers of the association then enjoyed a most delightful banquet in the Old Pueblo Club rooms of Tucson, given by the University Club of the city.

Following is a list of members in attendance at the 24th Annual Session of the Arizona State Teachers' Association:

OFFICERS

R. B. VON KLEINSMID.....President
C. F. PHILBROOK.....Treasurer
DANIEL F. JANTZEN.....Secretary

MEMBERS

NAME	ADDRESS
Arnold, Lucille.....	Globe
Baker, Stella.....	Bowie
Baker, Supt. W. O.....	Prescott
Barkley, Bessie J.....	Tempe
Benedict, Helen S.....	Cochise
Bennett, G. C.....	Cochise
Bland, W. P.....	Globe
Boehringer, C. Louise.....	Yuma

NAME	ADDRESS
Boyd, Estella.....	Willcox
Boyd, Meryl.....	Globe
Brinton, Paul H. M. P.....	Tucson
Brown, Supt. J. W.....	Apache
Bunch, E. C.....	Benson
Butler, G. M.....	Tucson
Cardon, Ellen S.....	Tucson
Carpenter, W. W.....	Phoenix
Case, Supt. C. O.....	Phoenix
Catlin, C. N.....	Tucson
Heywood, Supt. S. C.....	Safford
Colodny, I.....	Tucson
Colodny, Pauline I.....	Tucson
Colvin, H. M.....	Tucson
Collins, Josephine.....	Bisbee
Cook, Curtis E.....	Phoenix
Cook, R. Thane.....	Phoenix
Cornelius, G. E.....	Winslow
Crooke, O. C.....	Bisbee
Crozier, Mabry.....	Globe
Cunningham, W. S.....	Tucson
Cummings, Byron.....	Tucson
Daniel, Margaret.....	Globe
Davis, J. A.....	Clifton
Davis, Homer.....	Glendale
Dawkins, Albert.....	Willcox
Dickenson, Jessie A.....	Tempe
Douglass, A. E.....	Tucson
Du Puy, Fred J.....	Gila Academy
Dykes, Frank.....	Phoenix
Edwards, Lillie A.....	Willcox
Edwards, Ray.....	Globe
Elliott, F. E.....	Yuma
Elliott, Lloyd C.....	Phoenix
Enge, Hilda C.....	Willcox
Erickson, Lillian.....	Willcox
Ferrell, Elizabeth.....	Globe
Fegtly, Samuel M.....	Tucson
Feland, Dabney.....	Phoenix
Ferguson, Mrs. Marie.....	Globe
Foster, H. H.....	Tucson

NAME	ADDRESS
Fox, Alice.....	Globe
Francis, Lenora.....	Flagstaff
Fram, R. R.....	Gleeson
Frazier, A.....	Tucson
French, Emma B.....	Tempe
Frisbee, Minnie K.....	Bisbee
Frost C. W.....	Benson
Fuller, I. N.....	Miami
Gambee, H. C.....	Phoenix
Gerald, Genevieve.....	Globe
Goggin, Supt. C. A.....	Morenci
Gregg, Dorothy I.....	Bisbee
Hart, J. W.....	Prescott
Hefley, Nora.....	Globe
Hibner, D. M.....	Safford
Holcomb, Gladys.....	Benson
Hoogestaat, W. O.....	Prescott
Jantzen, Daniel F.....	Phoenix
Jay, Gertrude.....	Phoenix
Jennings, S. J.....	Tempe
Johnson, Ruby M.....	Ft. Huachuca
Kempf, Annie.....	Benson
KleinSmid, R. B. von.....	Tucson
Latham, E. V.....	Williams
Lee, Ora.....	Bowie
Lewis, O. A.....	Buena
Leonard, Heman Burr.....	Tucson
Lindsay, Nelle E.....	Globe
Lindsay, Edward Y.....	Bloomington, Ind.
Linville, W. L.....	Kingman
Lintz, Minnie.....	Tombstone
Lutrell, Estelle.....	Tucson
Loper, John D.....	Phoenix
MacAfee, Florence S.....	Yuma
McCall, Sallie J.....	Bisbee
McComas, Ruth.....	Phoenix
McClellan, H. M.....	Willcox
McDaniel, Ida.....	Phoenix
MacDonald, Adelaide.....	Globe
McKowen, Mattie.....	Benson
Maddocks, Irene.....	Globe

NAME	ADDRESS
Madden, G. H.....	Nogales
Mathews, H. E.....	Phoenix
Mathews, A. J.....	Tempe
Merrell, H. B.....	Benson
Meserve, Chas. A.....	Tucson
Miller, Curtis W.....	Prescott
Morgan, Geo.....	Glendale
Mullen, J. O.....	Tempe
Mullen, Edith.....	Phoenix
Murray, Estelle.....	Globe
Neal, A. O.....	Tucson
Payne, S. D.....	Tempe
Peterson, A. C.....	Thatcher
Philbrook, C. F.....	Bisbee
Phelps, Ruth G.....	Benson
Pollock, Nellie M.....	Phoenix
Post, Anita C.....	Tucson
Potter, J. B.....	Bisbee
Pulliam, M.....	Willcox
Randle, F. S.....	Benson
Randall, C. W.....	Phoenix
Rector, Eva G.....	Tempe
Riggins, J. A.....	Phoenix
Riggins, Mrs. J. A.....	Phoenix
Reid, Ida C.....	Tucson
Robertson, H. Q.....	Benson
Robertson, Mrs. H. Q.....	Benson
Roberts, Helen C.....	Tempe
Row, E. A.....	Tempe
Ryan, Frank M.....	Globe
Scherts, Meriam.....	Globe
Scott, Carroll L.....	Phoenix
Scott, E. Oriole.....	Phoenix
Sherwood, Supt. Geo. C.....	Mesa
Seward, Ella Page.....	Phoenix
Smith, Stella.....	Benson
Smith, Geo. R.....	Globe
Soule, O. M.....	Phoenix
Sullivan, F. J.....	Florence
Snyder, Myrtle.....	Benson
Spikes, A. R.....	Bowie

NAME	ADDRESS
Starke, Effie.....	Globe
Stokes, M. M.....	Picacho
Tagge, H. F.....	Globe
Tilford, C. E.....	Tombstone
Toland, Jessie May.....	Bisbee
Thompson, Helen.....	Dos Cabezos
Tucker, Mary.....	Globe
Tupper, C. R.....	Globe
Vickers, Lillian.....	Bisbee
Walker, Gladys.....	Nogales
Wadlington, Mary E.....	Clifton
Wiggs, Vera.....	Pearce
Wien, Irene.....	Johnson
Wilkinson, Nellie B.....	Phoenix
Whitfield, Sarah M.....	Phoenix
Wright, Earle.....	Globe
Yeingst, Wilbur M.....	Mesa
Yoke, W. C.....	Yuma
York, Mattie A.....	Tempe

Bulletin No. 53

Safety Series No. 16



27

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Bulletin

State Safety News
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Safety

Efficiency

BULLETIN No. 53

FEBRUARY 27, 1917

COMMENTS ON THE STATE ANNUAL MINE RESCUE AND FIRST AID CONTEST—PHOENIX, NOVEMBER 14, 1916

BY WALLACE McKEEHAN

At the time these contests were held I promised myself that some time in the near future I would air my views concerning contests in general and this one in particular, but upon mature reflection I decided to wait until the smoke of battle had cleared, the wounded fully recovered and the landscape once again serene.

Do State Contests Pay? personally, I think not. These contests were originally gotten up as a publicity stunt to show the balance of the state what the mining companies were doing. Again, they were supposed to provide an incentive for the employees, so that they would be eager to take the training.

As a publicity measure the three contests held have had little value, for the reason that the average citizen considers it a corporation matter, something in which he has no interest, and from which neither he nor the state will derive any benefits.

As an incentive it is a rank failure, for the reason that the rank and file are well aware that while many are called, few are chosen, and that these few must be so far above the average in dexterity, quickness and ready wit, that the ordinary man is barred. If it were possible for all men to enter these contests, they would be of some value as furnishing an incentive, but under the best of conditions, this can never happen.

State contests are held at considerable expense to the companies sending teams. Taking everything into consideration, I would say that a conservative amount would be \$1,000 for each team entered. While some companies may get off with a lesser sum, the average will not be far from this figure. One company that I have in mind must have spent considerably more. Would it not be better to use this money at home in providing something that will be of benefit to the largest number?

If state contests are to be continued, I, for one, will object to holding these in Phoenix, more especially if held at the Fair Grounds

and during fair time. I want no more contests under the auspices of the State Fair Commission, and the reason is plain: The people who attend the fair are not interested in exhibitions of this kind. The major portion come to be amused, not instructed, and will give the exhibition the once-over and then beat it. What is the use of spending a lot of money to put on a show, if you can't draw the crowd?

State contests to have any value, and this will be purely local, must be held in some mining district, the larger the better. By rights, the Globe-Miami District should have had the contest last year. In a mining camp practically all of the people are interested and have some knowledge of what the local companies are doing, consequently, when the district champions meet opposing teams, especially if from a distant part of the state, there will be a good turn-out and the spectators will understand what the boys are doing or trying to do. This statement can easily be proven by comparing the number of spectators who viewed the contests held in Bisbee in 1915, when thousands visited the ball park—this being the largest gathering that had ever been seen in the Warren District—with the meagre few who witnessed the two Phoenix contests. In Phoenix quite the contrary happens. Not one spectator in a hundred could tell the difference between a First Aid contest and a baby show—not even if they saw the triangular bandage. If we must have a state contest, by all means hold it in a mining camp!

Right here I want to go on record as objecting to the dress parade stuff pulled off at the last contest, particularly in the First Aid exhibition. First Aid men are supposed to do just what the name implies, i. e., apply emergency dressings, not put on fancy bandages, guaze pads and special splints, that would put the average doctor or hospital nurse to shame. My idea of a First Aid man is one who can take a piece of clean gauze, a gunny sack, his jumper, and a few pieces of board, and with this elaborate equipment treat a compound fracture and deliver the injured man to the doctor in good surgical condition. Contesting teams should not be allowed to use any but the simplest dressings; I will even go so far as to say, nothing but the metal First Aid package. At least I would confine them to plain gauze and triangular bandages. The use of the roller bandage should be prohibited for the reason that in applying it the First Aider is using time that should be devoted to getting the patient to a doctor. We must be sure that the First Aid treatment does not infringe upon the work of the surgeon.

Then again, I would insist upon a strict observance of the rules

for bandaging as laid down in the Miners' Edition of the Red Cross Text Book.

No team should be allowed to compete that is in a uniform of any description. While a neat, natty appearance may not affect the scoring of the judges, it is a cinch that it does not cause them to make extra discounts, and it does have a depressing effect upon the contestants not so attired. In a contest the men are supposed to be working under actual conditions. This being so, why not have all appear in jumpers and overalls, thus giving an even break, as far as appearances go, to every one?

Another thing that I believe needs correction, is that of greater uniformity in the First Aid equipment, and boxes or cabinets. Some teams have every tool, device or apparatus that can possibly be used, while others have little or none. Again, the cabinets of some teams are large enough to load down a truck, while others carry their supplies upon the field in their arms. Why not simplify these things and put these matters upon a more even basis?

Another thing that is of supreme importance in First Aid contest work, is that of allowing men who do office or light work of any kind to compete with men who do manual labor. Whenever this is done, the latter are put under a severe handicap and can seldom win. The men whom we wish to reach with our First Aid instruction are the ones who are doing the actual work, for they are the ones who are getting hurt. Men who labor have toil-hardened hands with stiffened fingers and should not be expected to compete with supple fingered gentry who follow lighter vocations. Men who toil in mines, mills and smelters should have equal rights with all other employees, in fact, I believe they should have a shade the best of it, and in future contests I would suggest that no one but the workers be allowed to compete, or if this is not satisfactory, that separate purses for each class be provided.

I believe that it is only a question of time until all contests will be done away with, or at least confined to inter-company or local meets. A better plan will take the place of these, and that is the paying of a fixed bonus to all men who give the injured correct First Aid treatment. This arrangement will provide the incentive so much desired in this work and will put all trained employees on an equal footing. This system need cost the companies no more than the sending of a couple of teams to a state contest and will prove far more beneficial as to results. If the Copper Queen Company's mine department had given \$4.00 to each man who gave First Aid treatment to an injured employee, they would have been out less money

than they were in sending two teams to the Phoenix contests, and it is not necessary that any such sum be paid, in fact, the bonus should be a graded one.

The giving of a bonus for proper First Aid work is something that I expect to see taken up by every up-to-date company just as soon as a good working arrangement for the reporting of all cases treated, with their rating, can be secured. This will doubtless require considerable thought and effort in working out a suitable system for each company's operations, but I believe that it can and will be done.

I desire to make but few comments regarding the Mine Rescue contest. The less said about any rescue contest, the better. These were originally put on as a spectacular stunt for the benefit of the layman, and he was given to understand that men wearing oxygen apparatus could travel at will through the workings of a mine filled with dense smoke and gas, the heroic rescuers bringing entombed miners to fresh air and safety. This is far from the truth, and men trained in the fighting of mine fires look upon these contests as merely dress parade affairs and know that the contestants are simply playing to the grandstand.

The chief thing that makes a rescue contest a good deal of a farce is that actual conditions in a mine fire can not be duplicated and these conditions can not be imagined by the spectators. The problems or events submitted to the contesting teams at all contests invariably call for the rescue of live men and the bringing of them through irrespirable gases. This type of problem has little foundation in fact and is entirely misleading. I doubt very much if there is one authentic case of men, wearing apparatus, bringing out alive, through gas and smoke, a single miner. That rescue men have made such efforts is all very true, but if the man was alive at the start, he would be dead when brought to safety, and rescue crews who undertake such stunts are running desperate chances of meeting with disaster themselves. In case of fire in a metal mine, the men will get to fresh air by their own efforts, or else will soon be dead. In a coal mine, conditions are somewhat different, more especially if an explosion has occurred, but even then the value of apparatus men in saving life is problematical.

No oxygen apparatus on the market today is dependable. The parts are too many and too complicated and delicate to withstand the hardship and wear essential in any apparatus used in fire fighting. Then, the supply of oxygen is not sufficient for strenuous work or long trips. Seldom will it be found that the five sets of apparatus

worn by the rescue squad are working in unison. While the supply of oxygen is supposed to be sufficient for two hours, in ordinary fire fighting an average of about one hour is all that will be secured. The work of a crew wearing apparatus must be governed by the action of the man wearing the least efficient equipment.

To one who knows the limitations and weakness of the apparatus, the successful carrying out of problems such as were submitted at Phoenix, in which men were supposed to travel approximately 1,000 feet through smoke and gas, half of this distance carrying a man on a stretcher, was merely a matter of luck. These problems could not be carried out under actual mine fire conditions and if undertaken, would surely result in loss of life by the men in apparatus. The problems submitted should consist of fire fighting, the use of brattice in putting up stoppings and the splitting of workings to supply fresh air, and to care for smoke and gas. In fact, the contests would have more value if the events were confined to the saving of property.

Men who are experienced in the handling of mine fires place more dependence in the use of portable blowers, these generally being supplied with current from mounted storage batteries; in the use of brattice, which alone can be handled to good advantage; and in the control and direction of the ventilation, than they do in men working in apparatus. The chief value of these men is that they form an advance squad preparing the way for the real workers who follow. Apparatus men should never be allowed to go more than 500 feet from their fresh air base, and even this distance is too great. The more I have to do with oxygen apparatus, the more I realize its limitations and the danger that men run when working in it.

There has been too much brass band stuff put over on an unsuspecting public regarding the use of the apparatus in saving life. Let us get down to brass tacks and say that it is of value in saving property when used in connection with other fire fighting equipment and incidentally may be of value in life saving, provided all conditions are favorable.

I wish it distinctly understood that I am not finding fault with this particular contest. It was as well staged and handled as any of its fellows, and the men who were in charge gave a great deal of time and study to perfecting the arrangements. My criticisms are aimed at contests in general, with the sole idea of having these put on a practical basis or else abandoned.

Mr. McKeehan has brought up in the preceding article a question that is well worthy of discussion;

and there is probably no better time in the year to discuss it than the present, owing to the fact that the next year's contests are a considerable distance away. The State Safety News will be pleased to publish any letters regarding the same, either concurring with or opposing Mr. McKeehan's opinion, and would like to get many opinions on the subject.

Insufficient sleep endangers the health.

SAFETY FIRST

Recently, when the talk turned upon the doings of embryonic engineers, the Old Timer related the following incident: It happened at Alta not many years ago. Soon after the ore was first opened in the old Columbus Consolidated, an eastern stockholder wrote to Superintendent Jacobson asking for a place for his son, who had just left college. He was given a job—beg pardon! he accepted a position; but, instead of being put on as a mucker or trammer, where he belonged, he was assigned the place of helper to an experienced machine man. Things went fairly well the first shift, with the miner doing all the work and the engineer standing around and looking wise. That is, things went well until the round was in and the holes were loaded and ready to shoot.

The miner explained the next step carefully, assigning to his new helper the task of holding the extra candle, to supply a light in case of need. The tenderfoot who has been in the breast when a round was lighted, and who has seen the spitting, writhing fuses through the curling smoke clouds as the miners go methodically about their task of "shooting," will appreciate the feelings of the young engineer at that time. The first fuse was lighted without incident, as was the second; but the third blew out the light.

Turning quickly for another, the miner caught a glimpse of his helper fifty feet down the drift, running like a scared coyote making for home and mother.

"Here, bring back that light!" he yelled.

And the answer floated back out of the darkness: "Not on your life! Do you think I want to stay in there and be killed?"

And he continued his get-away to the open air, though the round was ruined and it was found necessary later to dig out four missed holes.—SALT LAKE MINING REVIEW.

UNDERGROUND TRANSPORTATION OF MEN AT THE INSPIRATION MINE

The men employed in some of the stopes of the Inspiration mine farthest from the main shafts, through which they enter and leave the mine, are transported to and from the stopes on passenger cars designed and used only for this purpose. These cars are remodeled timber trucks, about nine feet long, with chain couplings. The frame of each truck is covered with a 2x12 plank floor about four feet wide, and along each side of this floor a seat has been built. Steel straps, bent to a "U" shape, are inverted over the ends and center of each car, and poultry wire is stretched over these supports from one side of the car to the other. This superstructure is high enough to allow the men to sit upright on the seats; yet prevents them from standing erect. Bumpers are provided to keep the cars a sufficient distance apart to allow the men entrance, and protecting steel plates project from the superstructure of each car above these bumpers. The arrangement is, therefore, such as to make it impossible for a man either within or about to enter or leave one of the cars, to stand erect and come in contact with the drift timbers. Each car has a seating capacity of twelve, and at present ten cars are made up into a train. One of the regular ore-hauling air locomotives is detailed at the beginning and end of each shift to pull the passenger train. A signal gong is mounted in the forward car, just behind the locomotive, and a wire cord is carried along the superstructures of the cars from the gong to the rear end of the train. Should anything go wrong, anyone at any point in the train can stop it at once by pulling the cord and ringing the gong. The cars are kept during the shift on an otherwise unused tail track. The cars are regularly cleaned, disinfected and inspected. The cleaning is done with compressed air. The disinfectant is made up in liquid form and applied with a spray.

The passenger train has right of way over all others. It is the first to leave the main shaft station at the beginning of a shift and the last to leave the stopes at its close. At the suggestion of one of the men, a red tail light has been added to its equipment to aid in distinguishing it from other trains.

It has been found that the use of this passenger train is advantageous in several ways: First, there is probably a slight saving of time in getting the men to the stopes; further, the walk to and from the main shafts is eliminated. The greatest advantage, however, lies in the great reduction of the number of men traveling on foot

through the main haulage drifts. This is a matter of safety and is in itself of sufficient importance to more than justify the use of this train.

Light promotes cleanliness.

THE NEGLECT OF TRIVIAL INJURIES

Writing on "The Neglect of Trivial Injuries," Dr. C. T. Sturgeon, of the Old Dominion medical staff, says in The Old Dominion Bulletin:

Around mines and industrial plants accidents are likely to happen. Sometimes serious ones and sometimes slight ones. The slight accidents will amount to nothing if properly cared for, but if neglected will often have dangerous results. Cuts, bruises, sprains, puncture wounds by nails or candlesticks, foreign bodies in the eye and burns are some of the trivial wounds which, if neglected, may result in serious infection. How often a man comes to the doctor's office with an infected finger or hand. One of the first things he says is that four or five days before he had a small scratch or cut, but thought that it did not amount to anything and did not want to bother the doctor. You are not bothering the doctor, for the latter would rather take care of a small injury for a few days than take care of an infection for a month.

These infections are caused by disease germs that find lodgment in the wound from outside sources, from the clothing, or anything that comes in contact with the wound. In consequence there may be danger of blood poisoning. Even scratches or pricks, when not properly cared for, may result in infections which may disable a person for a considerable time or cause the loss of a limb or even life.

The first thing to do upon receiving a slight cut or bruise is to go immediately to the First Aid box and put a clean dressing on it. Do not attempt to clean it out yourself, as in the majority of cases you only rub the dirt deeper into the tissues. Keep the wound covered until your shift is finished; that at least will keep out more dirt. Then go to the doctor's office, where he will clean it out and dress it for you, and in a few days it will be healed. In case it is impossible to come to town to see a doctor, the next best thing is to clean it out yourself. We use benzine, in which a few crystals of iodine have been dissolved, to clean the wound, but gasoline does almost as well and is much easier to obtain. With benzine or gasoline clean out the wound; also the surrounding skin. After the skin has dried, apply tincture of iodine to the injury and surrounding skin. Let the iodine

dry and then wrap it up with a clean piece of gauze and daily apply iodine and clean dressings until healed, for it is just as important to keep out dirt after the first dressing as it is to first clean out the wound.

With reference to puncture wounds by either candlesticks or nails, it is very important that these injuries be seen immediately by a doctor. First cover the wound with a sterile piece of gauze from your First Aid box, then do not wait to finish your shift, but go at once to the hospital to have the wound dressed, for a few hours' delay in sterilizing these wounds may mean a very serious infection with a long period of disability.

Trouble is often caused by a foreign body in the eye, whether it be dust, a piece of rock or steel. Upon receiving such an injury, immediately go to the hospital or office. Do not allow a fellow employee to try to remove anything from your eye with a toothpick or match, for you run the risk of an infected eye which may mean the loss of sight. After the foreign body has been removed by the doctor, keep on reporting daily until discharged, as only in that way can the best results be obtained.

In case of a sprained wrist, ankle or muscle, do not be content to send to the office for a bottle of liniment, but report for examination. A plan of treatment will then be outlined for you, as all sprains do not respond to rubbing. Some have to be strapped, others have a splint applied for a few days in order to keep the parts absolutely quiet.

With regard to slight burns, the same general rule applies. Have the burn dressed and keep it dressed until it is healed.

In this article I have tried to make clear that trivial injuries should not be neglected. An ounce of prevention is worth a pound of cure. The proper care given immediately will result in the saving of much time and suffering. Of all the directions given, the chief and most important one is—see the doctor without delay.

Fresh air, food, rest—these three combat tuberculosis.

REMEMBER AND—

Always return for medical treatment at the time you are told to. Delays are dangerous.

Always go and see a doctor promptly when injured, no matter how trivial the injury may seem to you. Better be sure than sorry.

ONE MAN AMBULANCE

At the Raimund mine of the Republic Iron & Steel Co., in the Birmingham district, Ala., an ambulance particularly adapted to quick service has been recently put into use. It consists of four ordinary 28-inch bicycle wheels and front forks, rigidly fastened together with a 1 inch pipe frame, the front wheels being provided with a steering lever. It has a 59½-inch wheel base, 22½-inch tread, is 36 inches high and weighs only 91 pounds. A canvas stretcher of the common type is set on the top of the ambulance frame, the hand holes on the side easily slipping over the extended posts on the frame and thus preventing any movement of the stretcher after it has been once placed in position.

When a man is injured in the mine he is placed on a stretcher, which is then suspended in the 10-ton ore skip in a horizontal position by light chains hung from the front and rear of the skip. On reaching the surface the stretcher is lifted out of the skip and set on the ambulance, which one man easily steers and pushes to the emergency hospital.

Abundant fresh air will prevent more disease than will unlimited medicine.

"YOUR LITTLE WIFE"

BY WILLIAM F. KIRK

Who plans to make your future bright?

Your little wife.

Who cooks to tempt your appetite?

Your little wife.

Who tells her women friends that you

Are one grand husband through and through?

Who's the best girl you ever knew?

Your little wife.

Who pats your cheeks when you get home?

Your little wife.

Who smooths the thin hair on your dome?

Your little wife.

Who looks at you, her brown eyes clear,

And, snuggling to you, extra near,

Says, "This is pay-day, ain't it, dear?"

Your little wife.

—THE ANODE.

University of Arizona Bulletin

BULLETIN No. 54

EDUCATIONAL SERIES No. 2

PROCEEDINGS OF THE Arizona State Teachers' Association

TWENTY-FOURTH ANNUAL SESSION
AT TUCSON, ARIZONA,
APRIL 12-13-14, 1916

PART II
ADDRESSES



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EDUCATIONAL BULLETIN

BULLETIN No. 54

FEBRUARY, 1917

ADDRESSES

WHAT MAY BE EXPECTED OF THE HIGH SCHOOL (Summary)

By PRINCIPAL R. T. COOK, PHOENIX HIGH SCHOOL

In discussing any such question as this, one must limit his remarks to some one phase of the question.

Too much is expected of the High School. The High School can not do everything. What it shall do and what it shall not do must be answered on the basis of relative values.

I take it that the chief purpose of the High School is the work of the classroom. All other affairs should be subsidiary. If the circus is going to be swallowed up by the side shows, we should cut out the side shows. The athletics, social affairs and all organizations of the school are only means to the end. If they become ends in themselves, they are liable to be dangerous. They should help the school. If any one activity becomes a hindrance to the school, it should be abolished. Too many of our school affairs cost more than they are worth. It is poor business to put in two hundred dollars worth of time and energy on a twenty-five dollar show.

Regular and prompt attendance is very much to be desired, but for the teacher to spend a large part of her class time lecturing those who are regular on the absence of those not present is wasteful to say the least.

Supervised study may be a very good plan, but if we are to pay teachers to help pupils do work which they themselves should do, then we are worse than wasting our finances.

The home has thrown many things onto the school in recent years. It is a common belief that the High School should be responsible for practically all the child's activities.

He must learn how to saw and build. He must be fed at noon. His social nature must be developed in the evenings. A chorus should be conducted mornings. He must be entertained on Saturday by athletic contests. Some system should be devised for the moral and religious training. Ethics and sex hygiene should be included in the course of study. In fact, the modern tendency would place

the whole present and future of the boy's and girl's life in the hands of the school. The school should discover his talents and fit him into his future employment. The home is, however, still a place for the child to eat occasionally, and sleep once in a while. He can also be told at home that pupils cannot write and spell as they did when father and mother were young.

If the school is going to do so many more things, it must not be expected that it can do all things equally well.

WHAT MAY THE HIGH SCHOOL EXPECT OF THE GRADES

BY SUPT. J. A. DAVIS, CLIFTON

What is the high school? i. e. Purpose.

1. Higher grades, continuation.
2. Review, fitting for teaching, etc.
3. Preparation for college and life.

The high school in some form or other has fitted in between the elementary schools and the college since the days of the Revolution. Gradually it came to be that the only door opening into the high school came from the elementary schools, where for eight or nine years the pupils were made to believe they were getting ready for an education and in the high school they were to acquire this education, or to prepare for another education which was just a little further on.

Now we are kicking back and saying that the elementary school is not as efficient as it ought to be—that the students who come to us are not properly prepared. That there is a lack of articulation between the two no one will deny, but who is to blame and why? The real reason, I think, lies in the differences of aim, function, methods and general organization of the entire system of education of which the elementary and high schools are only parts, and not the units of the educational machinery.

The aim should be to give more practical training and social efficiency. The function of the entire school curriculum is to prepare for life now—preparation *in* living, not *for* living.

Dewey says: "The aim of the elementary school is wrong. It should not be knowledge, but to organize the instincts and impulses of children into working interests and tools. The stress should be on methods, not results. Not that we do not want results, but that we get better results when we transfer the emphasis of attention to the problem of mental attitude and operation. We need to develop

a certain active interest in truth and its allies, a certain disposition of inquiry, together with a command of the tools that make it effective, and to organize certain modes of activity in observation, construction, expression, and reflection. Six years ought to be enough to accomplish this task."

Hanus sums it up as follows:

"The special aims of elementary education are: (a) To nourish the mind of the child through the course of study which should comprise an orderly presentation of the whole field of knowledge in its elements, and to provide an opportunity for the exercise of all his powers, mental, moral, aesthetic, manual, or constructive, through good instruction and wise discipline; (b) To guard and promote his normal physical health and development."

Thus, besides promoting and strengthening one's physical health, elementary education has for its chief aims the opening of the mind to the entire world in its elements, the development of interests in the world and in its activities, and the fostering of desirable habits of mind and body. It should emphasize chiefly the formal aspects of education. Its mission is to prepare for future school work and life. It aims, not at knowledge itself, but at supplying the tools of the mind and at inculcating attitudes and habits of mind that will enable the individual later to pursue knowledge and industry."

What is secondary education?

Hanus replies: "The secondary school especially promotes the discovery and development of each pupil's dominant interests and powers; and further, it should seek to render these interests and powers subservient to life's serious purposes, and also to the possibility of participation in the refined pleasures of life." He adds: "The serious purposes of life are: first, self-support, or when this is unnecessary, some worthy form of service; second, intelligent active participation in human affairs. * * * The refined pleasures of life are found in the ability to participate with intelligence and appreciation in the intellectual and aesthetic interests of cultivated men."

E. E. Brown declares "the business of secondary education (is) to raise all subjects which it touches to the plane of science by bringing all into the point of view of organizing principles." Again he says that the purpose of secondary education is "to seek an understanding of the living growing persons who go to school and to treat them in a way to promote their healthy growth. * * * This is on one side leading toward individualism; it demands free election of studies and individualized processes of instruction. On the other side it

shows how dependent the pupil is on society. Neither the future nor wholly the present are our concern, but both."

By Liddeke, the aim of secondary education is given as "an elementary knowledge of facts, truths, and laws of relation in the domain of science, history, government, and literature; a fuller development of loyalty to the bettering influences, culminating in due time in seriousness of purpose; last and most important, depth of insight, sanity of judgment, and the power of adapting means to ends."

And, as Davis says, the distinguishing characteristic of secondary education is "that education which lays stress upon gaining a systematically arranged content of knowledge, and that seeks first to discover for each pupil his real dominant interests and aptitudes; and, secondly, so to train and develop these incipient powers that each may put into life as much social service as possible, and simultaneously derive from life as much personal satisfaction as may be. Trained individuality is the end and aim of secondary schools; but a trained individuality that ever recognizes these principles: that individual progress and happiness are always dependent upon the progress and happiness of all the other members of the social group, that whatever serves the best interests of the social whole, serves at the same time the best interests of the individuals who compose that whole, and that the distinguishing characteristics of individuality are a trained and accurate judgment and a vigorous persistent will. Active social co-operation, clear judgment, and effective execution are, however, produced solely through the repeated exercise of these incipient powers. Hence the prime function of the secondary school is to afford abundant opportunities for the development of these processes."

Now, with these purposes of both elementary and secondary education before us, let us see what the secondary school—the high school—may expect from the elementary school—the grades.

From the distinctions that have been made of the elementary school and the high school it follows that:

1. The high school may expect instead of an overcrowded curriculum a diversified one—one with some optional subjects of vital interests to the child; in this the high school may have to drop down into the grades with subject matter and methods as well. But why shouldn't it?

2. The work in the grades should be continuous, thus avoiding the error of duplication and repetition which leads to so much waste.

3. There should be more correlation of subject matter and less of subjects as such.

4. The nonessentials and impractical topics should be eliminated and an intensive study made of what is left.

5. All obsolete material should be classed as waste and forgotten.

6. Some subjects should be brought back to the grades and taught in the manner that high school subjects are being taught and a few of the grades should be continued in the high school, thus more closely articulating the grades and high school.

7. More attention should be placed upon the individual tastes and capacities and less on the machine grind which now so much characterizes the grade work.

8. Promotions should be made upon what a child may be able to do rather than upon what he has done. Upon a subject rather than upon a group of uncorrelated ones.

9. There should be a saner discipline more suited to the stage of development of the child.

10. The teachers should be more thoroughly equipped and fewer of the mediocre accepted.

11. There should be more departmental work, thus bringing pupils into contact with more personalities of teachers and better methods of instruction at the same time.

12. The work should be more in the line of the vocations.

13. Pupils should be encouraged along the lines of natural inclinations, thus holding more of them in until the end of the elementary course; special provisions should be made for the retarded pupils; those of superior ability should be allowed to go ahead.

14. Subjects employing the hand and mind should supersede or set aside the only "bookish" ones.

15. There should be more specific trade instruction; of course, in a rudimentary way.

16. The entire school system should be less mechanical, giving more opportunity for self-activity of mind and body purposely and consciously managed by more capable teachers.

17. The pupils should be taught in better habits of application, concentration, and industry. That is, the habits of study and of boy and girl life should have been well formed by the time they are admitted into the high school life. They should expect to stand on efficiency and merit and not on bluff.

18. They should have acquired a fondness for study and not to assume that every subject will be dull and uninteresting.

19. They should come to the high school physically able and free

from tobacco and alcoholic habits and pool hall, card room, and loafing habits. There should be, in brief, a business attitude in all their school activities—an attitude of aggressiveness.

Then, to summarize:

It seems to me that the high school may expect of the grades of the elementary school:

1. Reasonable proficiency in the so-called fundamental subjects, i. e.
 - a. Ability to read.
 - b. Ability to express in words thoughts gained from reading.
 - c. Ability to express in writing thoughts gained from reading and conversation.
 - d. Ability to do simple number work.
 - e. More or less information in geography and nature study.
 - f. A certain knowledge and appreciation of myths and child literature.
 - g. Some ability to do simple construction and manual training work.
2. Habituation to the conditions of school work, including
 - a. A reasonable mastery of the art of study and a fondness for it, habits of application, concentration, and industry.
 - b. A clear and healthy body free from experiences with tobacco, narcotics and alcohol.
 - c. A normal physical body without defects as to sight, hearing, curvature of the spine or similar handicaps.
3. Particularly the pupils who come to the high school should not be blasé. They should be enthusiastic, teachable, docile. They should have been kept away from the excitements and seductions of the street. They should have habits of regular study outside of school, not for long hours at a time, but some study each day. They should be more interested in their school work than they are in the street, and they should have higher regard for teachers than they have for keepers of pool rooms and amusement halls.
4. Lastly, they should have had teachers who inspired respect and won the esteem and good-will of the pupils.

HAS OUR TEACHING OF LANGUAGE IN THE GRADES BEEN A FAILURE?

BY MISS ALLEGRA FRAZIER, TUCSON HIGH SCHOOL

In order to decide whether anything has been a success or a failure, it is necessary to accept a standard. We assume as a reasonable standard of accomplishment for all pupils who have had eight years

of language training in our schools, the ability to read and to write simple English with reasonable accuracy. Many of the graduates of our elementary schools are without such ability.

The remedy is concentration in our English teaching. We scatter, passing over many things and bearing on none; forgetting that it takes drill to substitute good habits for bad habits. If each year, from the first grade up, four or five faults could be eradicated—or to put it positively, four or five good habits could be formed—by *thorough drill*; and if thereafter the pupils could be held absolutely to the use of the correct forms in those cases, there would be no glaring faults left at the end of the eight years. Such a course is entirely possible. There are fewer of these errors than we imagine. Ten per cent. of the grammatical blunders commonly made are due to the misuse of the principal parts of four verbs.

There would be time, also, for a thorough training in grammar, beginning in the seventh and extending through the eighth year. This should by all means be included as a basis for the pupil's further study of language, whether English or a foreign tongue.

READING IN THE GRAMMAR GRADES, FROM THE TEXT-BOOK POINT OF VIEW

BY MISS NELLIE M. POLLOCK OF PHOENIX PUBLIC SCHOOLS

The timeliness of a brief discussion of this subject will not be questioned, I presume, by a large proportion of Arizona teachers. As is always the case, we are not all satisfied with the material at hand for our use in our reading classes. Sometimes these criticisms are definite, and are accompanied by thoughtful reasons in the mind of the critic. Sometimes they take the vaguest of forms, unaccompanied by any definite reasons for the teacher's dissatisfaction. It will be the attempt of this discussion to summarize the situation as far as possible from the point of view of the ideas advanced in the more thoughtful criticisms, in the light of the aims which we may reasonably expect to accomplish or those which we should accomplish in the grammar grades.

In the first place, we will all agree that the mechanical difficulties of reading should be conquered well before the child enters the grammar grades. By the time he has reached these grades he should be gaining, or ready to gain, (1) a real and vital interest in and love for literature—something which will ripen and develop into a life interest; (2) an appreciation for certain types of literary form, such as the short story; the tale; certain types of the essay—notably

those dealing with objective themes, nature studies, anecdotal papers, and the like; some of the fine orations, the occasion for which are within the range of the child's interests; lyrics—and here should be a relatively large number that would be worthy of memorizing, in whole or in part; epics, under which term would be included those poetic forms which follow the narrative principle, such as ballads, idyls, pastorals, sagas, and the like, as well as possibly some portions of the great epics—all of these to be chosen within the limits of the child's interests and range of experience, rather than that of the adult; (3) he should be gaining clear and definite ideals of conduct and character. Porter Lauder McClintock says: "It is impossible to overestimate the importance in a child's moral life of the contribution made by literature to his vision, his pattern of society and character. This ability of literature to influence the child's inner life and his conduct is so real that it has as many dangers as advantages. There must be no mistakes in selecting for him, if he is to ascend in dignity of being by the steps of literature. It must contain those pictures of life and conduct that are fit and suitable for the child to witness and possible for him to comprehend. They must be sound to the core, arousing and engaging his genuine interests and his best feelings."

To sum up, again quoting McClintock: "The literature we give the children should correspond to the stage of their development by matching, as nearly as may be, in tone and spirit their own activities and interests, or should be calculated to arouse in them those interests and activities they ought legitimately to have. It should be the kind that gives a large free sweep of activity; that reveals character and conduct in their simpler, open aspects, that exhibits literary art phenomena in their plainer, more striking varieties."

Remembering then that we are aiming in the grammar grades to arouse and strengthen a genuine love for literature, to secure an appreciation for certain definite literary forms, and to make it possible for the child to be so acted upon emotionally that his will will be aroused to act in the direction of fine and worthy ideals of character and conduct—and all of this by means of material that is adapted to the child's understanding and harmonious in spirit with the other interests he is pursuing—let us try to reach some definite conclusions regarding the kind of book we want.

First, I would say we want a book that will meet the needs of the farthest rural school, as well as that of the schools of the larger towns and cities. Indeed, we need a *better* book for the use of those

schools where it is difficult to secure good supplementary material, or where the teachers are still young in teaching experience or limited in training, than we would if all schools were fortunately equipped with liberal funds and thoroughly trained teachers of reading.

We need a book with *plenty* of material carefully selected upon the basis of *the child's* experience and interests; and of such a sort that we can reasonably hope by its aid to build up within him an abiding interest in and love for good literature, some understanding of and appreciation for those types of literary form which he is able now to understand and enjoy, and high ideals of character and conduct, without which every other equipment for life's battle is vain.

Do we need a method reader in the grammar grades? I think not. I would not forget for a moment that reading has, for one of its great phases, that of expression. But I believe that even expression will be had when the child is left unhampered by formal rules of expression, and encouraged to delve deep after the thought, and then to forget himself and try only to set that thought in such form and tone that he can get it into the mind of his listener. By putting into his hands a group of rules and principles which he will seek consciously to apply to certain formal examples there set down, it seems to me that we would be laying the emphasis upon manner rather than matter, quite the wrong place, if we really wish to accomplish the fundamental aims that lie at the bottom of our teaching of literature.

Should the teacher thoroughly understand the method that underlies the securing of desirable results of expression in any phase of literature? By all means. Only thus can she hope to secure satisfactory results in that important phase of her teaching of reading. But let the possession of the formal rules and principles of method lie with the teacher only. She may then direct, suggest, and develop best ways of securing good results of expression for all the very best material that is available, without being handicapped by the limits of a true method reader, whose contents have to be chosen upon the basis of best illustrating certain formal principles. In a method reader, the rules and principles *must* be illustrated and practically applied, at the very possible expense of some rarely fine material that doesn't quite fit.

In conclusion, we will all agree that a poor teacher will secure only mediocre results with the best of material, while a good teacher will succeed surprisingly well with second class reading matter.

**EDUCATIONAL TEAM WORK IN AND FOR ARIZONA—
THROUGH THE RURAL SCHOOLS****(Summary)****By MISS C. LOUISE BOEHRINGER, COUNTY SUPT. YUMA COUNTY**

The star playing of an individual here and there does not mean the highest success of the team. We need good players but we need more team work throughout the entire educational system in our state. It is the duty of those of us who have the rural schools under our direction to use every agency at our command to point the boys and girls up and on, and it is the duty of the high schools and higher institutions to reach downward to help the boys and girls up.

Team work may be carried on between the home and school through the parent-teacher associations and through the co-operation of teachers and parents in the Boys' and Girls' Club work so well organized and carried on by our university. The whole neighborhood becomes interested and takes part in the activities of the Caning Club and pig contests.

There is a possibility of much team work among the rural teachers of a locality, through professional and social organizations. The Yuma Valley Teachers' Association is only one of a number in the state. Teachers profit from the exchange of ideas and they are ready to present a united front in undertaking some movement for the best interests of the schools. Sociability among teachers is an excellent lubricant for the wheels of action in some community enterprise. It also opens the way for all sorts of contests—literary, spelling, athletic—among the schools of an extended area. Our annual Field Day brings together all the people for miles about and the boys and girls compete in athletic events and a group always winds the Maypole, while everybody sings and little children play games. Through these gatherings interest in neighborhood play is promoted and trustees and patrons are willing to make provision for suitable play apparatus on the school grounds.

We have been urging the matter of adequate school grounds (2 to 5 acres) and of developing the grounds into a neighborhood park. In one community the people came together on Arbor Day and leveled the grounds and planted over one hundred trees. For the Fourth of July celebration the people of the community raised money to build a pavilion on the grounds. Everyone had the pleasure of using it during the picnic and the children had the use of it all year. This year the people of the community will raise funds to put

a more substantial roof on the pavilion, making it a very complete play and dinner shed, for school purposes.

Three years ago we established our Annual High School Visiting Day, which is a big factor in educational team work. On this day all the boys and girls of the seventh and eighth grades of the rural schools are invited to spend the day in our Union High School. This day means as much to our country boys and girls as University Week means to our high school boys and girls. They are met by a group of young people who but a year or two previous were with them in the rural schools. They are invited to visit classes in literature, history, science and languages, all of which open up wider fields of study to them. The work in the laboratory is especially interesting to the boys. They find new fields of activity in the business classes, the sewing and cooking and in the music and dramatic art. At noon the girls of the cooking class prepared an appetizing luncheon for their guests. One year the student body rendered an interesting and varied program in the afternoon and after school invited everyone out to witness some athletic events as conducted by high school students. Another year some interesting typewriting contests were held.

When the day is over the boys and girls return to their various schools, enthusiastic about the privileges and opportunities in our Union High School and with a determination to do the work that will give them entrance.

Visiting days for teachers, so that they may visit some other wide awake rural teacher or may visit the high school or the university. This insight will enable them to point the way a little more clearly to the boys and girls who want to go on farther. For many boys and girls the teacher is the only one who can tell them of the opportunities and advantages of higher education.

The annual institute is one of the greatest factors in educational team work. It should offer something definitely worth while to *every teacher* and *patron* who comes within its reach. We favor the home institute because one of the most effective ways for local educational leaders to do real constructive work is to create a *proper atmosphere at home* for the *reception of live educational ideas*. This cannot be done when the teachers alone go away and nothing is given directly to the patrons of the school. A live demonstrator and worker brought into the community "leavens the whole loaf."

Parent-Teacher Associations under the right leadership are great promoters of team work. They make it possible for the teacher to secure better results in the school room and they make it possible

with the co-operation of the county superintendent to raise the standard of the schools of the county. They furnish the leaders for the Boys' and Girls' Clubs when the university sends their club organizer into the field.

All the way from the little rural school through the university there is need of educational team work. The field is so wide and the needs so varied that there is need for the closest co-operation. There can be no cause for jealousy—but the feeling should rather be one of "in honor preferring one another."

EDUCATIONAL TEAM WORK IN ARIZONA

BY STATE SUPERINTENDENT C. O. CASE

As helpful in securing educational team work in Arizona, I suggest the idea of having a program of work to be planned and carried out in detail under the supervision of the state administration in a co-operative way by all the educational forces of the state.

The following are some of the things that I believe should be included in the program:

1. The Standardization of Schools.
2. The Elimination of Illiteracy.
3. School Surveys.
4. Course of Study.
5. Thrift.
6. Reading Circle Work.
7. School Legislation.

The standardization of schools, the first measure in the list we have given, has been employed with good results in older states, but under conditions very similar to our own. All the state school superintendents this side of the Mississippi recently met at Denver and organized a western association. At this meeting Mrs. Mary C. C. Branford, state superintendent of schools of Colorado, made quite a hit with her plan on the standardization of schools. Here is the score card that she uses. Some of you may be familiar with her plan, having perhaps received circulars describing same. This plan, it is claimed, has done much for the schools of Colorado, especially the rural schools, and we could, we believe, with some modifications, adopt it with advantage in Arizona.

I have not time to explain Mrs. Branford's plan at length, or in detail, only to say that the plan carries with it committee investigation, and club work. It honors successful schools with a plate (the best schools getting a silver one placed over the schoolhouse door)

with suitable inscription designating rank of school. This is done with due ceremony, in a public way, at a big gathering, and in all there is a great deal to appeal to community pride, and interest in the building up of better schools.

There is today no state problem more important than the one pertaining to the elimination of illiteracy. Excessive illiteracy is a menace to any state in which it exists, and today along our border and in all our interior mining camps, this menace is steadily increasing and making its presence felt. It is high time that we inaugurate a campaign for its extermination. The church should have its illiteracy Sunday, the state should have an illiteracy day, the State Federation of Women's Clubs should take up the work, and every schoolhouse as far as possible should have a night school, as well as a day school. No schoolhouse door should be closed against any one for reason of his age, so long as the perpetuity of the free institutions of this state depend upon the intelligence and virtue of all the people.

SCHOOL SURVEY

The idea of a state school survey was started a year ago at a meeting of the State Teachers' Association, a committee on survey being appointed at that time. Later I was elected a member of this committee, and acting on the request of its chairman, Prof. Neal, I wrote the Commissioner of Education, Hon. P. P. Claxton, for assistance from the Bureau of Education. Dr. Claxton was prompt in response, offering to send blanks and detailed plans to be used by local parties, and also to send to Arizona early next fall, one of his field men to work with us in personally conducting the survey.

A school survey is all right if it is all right. We favor the Arizona school survey. We believe it will be a rational, sympathetic, constructive survey, conducted by a fair and able man, and that it will do much to help us see school conditions in Arizona as they are and as they should be.

COURSE OF STUDY

The state board of education should give, and is going to give, immediate and continuous attention to the preparation of an up-to-date, homemade course of study for our common schools. Measurements for it will be taken in our own school rooms by our own teachers. Standing committees will be appointed to assist in making out this course. In this way, in conformity with our adopted textbooks and in consistency with Arizona life and conditions, we hope to be able to work out for ourselves a course of study that will contribute much

more completely to the needs and to the success of our school work than the present course is doing.

THRIFT

The lessons of thrift have been taught ever since the time man entered the honorable business of "earning his bread by the sweat of his brow." They have come to us in Bible precepts, in the sayings of "Poor Richard," in the proverbial lore of nearly every nation and in many other ways. No nation can be safe and strong unless it inculcates these important lessons thoroughly into the thought and habit of the children it is preparing for citizenship. We as teachers should be active and earnest in imparting these teachings by means of thrift contests, savings bank schemes, and through our course of study.

The state board of education, we are glad to announce, recently adopted a special textbook on thrift to be read in our schools.

READING CIRCLE WORK

Reading circle work and school legislation pertaining to it in this state should go hand in hand. Twenty years ago in a gathering like this we broke the sod of our first reading circle work. With a big hurrah we hooked the team onto the plough, started and then stopped, and way back there in the furrow today stands the rusty plough where we left it twenty years ago, and all this for want of the proper legislative authority to provide the motor power for continuous work. For this important work and for other things that we need, we certainly do need some more school laws to help us out. We are going along at present without these laws, doing what we can, but at best our work in this way becomes, in too many instances, too much like the old Egyptian grind of making bricks without straw. We have some school law amendments here which we have not time to read, but which we should very much like to have considered in some way by the State Teachers' Association, securing its approval, if possible. These school law amendments have just been approved by the county superintendents of this state in an annual meeting held in Phoenix.

If there is one thing needed more than anything else in Arizona it is educational team work and the state department of education stands ready and anxious to join hands with other educational forces in co-operative work for the good of our common schools. Working thus in unison with sentiments and interests in common we shall learn more and more as we work, the meaning and the mission of co-operation in the miracle of achievement it will bring.

INTERESTING THE COMMUNITY

BY MRS. ELLA P. SEWARD, TEACHER IN MADISON SCHOOL

The very first essential is to interest the pupils. If the children become vitally interested in the school activities, the parents and their friends will soon follow suit.

To arouse the interest of the children, do something different; do something out of the old rut. The Three R's are all good enough in their places. Don't neglect the foundation studies, but as we enjoy sandwiches better than plain bread and butter, sandwich in between the regular studies some spicy, tasty ingredients.

People are pleased to know that their boys and girls are advancing in the regular routine studies, but they will not be overly interested in these ordinary common events, of which the children will say but little until you throw on some sort of searchlight to wake up the children; to let the people know the school is alive and a vital factor of the community.

If you find, upon lining up your school in the fall, that the children are in the habit of doing careless, poor, half-hearted work, think up some scheme to get up a little enthusiasm among the pupils, to arouse a wholesome rivalry or to cause a striving for better and more efficient work.

It doesn't matter so much what subject you get the children aroused in, but have them do some one thing that will result in a spirit of working together for the best welfare of the school. Here in Arizona there is always the state fair in November with its splendid advantages for a bit of educational exhibit. Suppose you can not hope to compete with the larger town schools, is there a father in your district who wouldn't be pleased to see "My son's writing," or a fond mother who wouldn't hunt in the booth to show a friend Jennie's apron or work bag? But you say, "This fair work is too much bother and is not regular work." Can you deny that it develops neatness, carefulness, and concentration on the part of the pupils and interest on the part of the parents? What more can you desire?

Of course, it is taken for granted that there is a Parent-Teacher Association in your district. If there is not, organize one immediately. Secure, if possible, a good president, who will co-operate with you in holding interesting meetings where the mothers may congregate and feel they are being repaid for leaving the home work one afternoon a month. Have a good speaker once in a while. Right along this line it does not seem to detract from the interest of the

Parent-Teacher meetings to have a few numbers on the program by school pupils, or for the domestic science girls to serve tea and cake or coffee and doughnuts. A picture contest is a good way to secure a better attendance at your Parent-Teacher Association meetings. Purchase a good picture, then let the room which has the largest per cent of parents and friends present have the picture for the following month. If any room wins out three times in succession the picture remains in that room and a new one must be obtained for the contest.

A notice in the paper as to the day of meeting may remind some mothers of their duty, but sending little invitations home by the children adds a note of welcome which may warm tired mother hearts.

Don't be afraid to ask your Parent-Teacher Association to aid you in your efforts to better conditions for your school. They always are willing to help. An evening meeting now and then for the fathers is a good idea. I attended one in a neighboring district the other evening, where the children gave a fine program consisting of a drill and folk dances, after which ice cream and cake were served to all present. You may be sure the whole community was present.

It is sometimes well to have a few speeches by the fathers, and also have the boys take an active part. A talk on athletics will be sure to touch a sympathetic cord. By the way, have you a few good athletes in your school? All right, interest the community in athletics. Organize an association, get the boys enthused (which is not a hard task) over their basketball, football or baseball games, then give some sort of an entertainment to raise funds. I know of one school where the boys assisted the domestic science girls in making gallons and gallons of ice cream—chocolate, vanilla and tutti frutti—while cakes, light and dark, were made and donated. The seats being removed from one of the rooms, it easily became a prettily decorated lunch-room from which the girls served cake and cream all afternoon and evening. The musical people of the neighborhood willingly contributed piano solos. Were the people interested? Ask the boys who dished the cream till their arms ached, and had money for suits and all sorts of athletic supplies.

Recently one of our small school principals secured the consent of her trustees for a half-holiday that her boys and girls might enjoy a ball game between their team and one of a nearby town. A special car was obtained to convey the pupils to the scene of conflict. Is the community interested? They all, old and young, turned out for a hay ride and picnic with the youngsters Washington's birthday.

You may not care for athletics: may prefer to develop a literary atmosphere; but there is no library in your school. How are you to go about getting the neighborhood to help? First, get up a Current Event Club; next secure by collection from pupils enough money for some five-cent classics. The pupils will be hungry for these books. You'll soon hear such remarks as, "Where can we get hold of David Copperfield or another one of Dickens' stories?" "Say, did Ruskin write any other stories as good as 'The King of the Golden River'?" The parents will not be long in discovering that the children enjoy the new reading lessons. Now you are ready for an entertainment or playette of some kind to raise a library fund. If you feel you can't possibly afford time and energy to drill the pupils along this line, call on your Parent-Teacher Association.

A P.-T. A. once gave a simple tea at one of the homes. An extra cup for contributions was on each table. People came and went any time from four to eight. They had pleasant chats over the cups of tea, listened to a few musical numbers and readings, while the contribution cups gradually filled to overflowing. In fact, it was such a success and the community responded so well that these teas became regular affairs whenever funds were to be raised. Once it was a Japanese tea where cherry blossoms and Japanese tea sets prevailed, while the ladies who served were attired in beautiful Japanese attire. Again it was a gypsy tea. There were gypsy children and fortune tellers galore. One P.-T. A. made a goodly sum by cooked food sales, and another by giving a play. All these methods of raising money not only create an interest on the part of the community as to the means of securing funds, but as to their use.

Usually the interest of any community is easily aroused by special day programs by the school, such as Thanksgiving, Christmas, Washington's Birthday, Arbor Day, May Day, Mother's Day or Bird Day.

Thanksgiving Day is so suggestive. There are the products of the harvest time, which are so easily secured for effective decorations. The Puritan fathers and mothers and the Indians may be the center of attraction, but a Priscilla and John Alden play is sure to take with old and young. Pumpkin and turkey invitations should be made by the pupils. It is also well to make posters. Let the children select their own designs. They may waste a bit of drawing paper, but will gain some valuable experience and perhaps surprise you with some really good and original posters. It is sometimes advisable to solicit donations of fruits and vegetables for some charitable institution at this season of abundance.

A Christmas cantata or playette at the school will never fail to bring out the whole community. Sometimes the pupils are willing to donate for a general treat. If this has been the custom it may not be amiss to continue it. If possible, have a real tree decorated with booklets and other inexpensive gifts the children have made for the parents. The boys of the manual training class will do their best to make good coat hangers, tie racks, pen trays, etc., while the sewing class will make collar, laundry and button bags, towels, aprons and handkerchiefs. Christmas stories, illustrated by drawings, or magazine pictures, Christmas cards, the spelling lessons in a stocking-shaped booklet, or the arithmetic lessons mounted in an appropriate cover make acceptable gifts to father and mother. Let the invitations be holly-decorated bells or stockings, the Christmas tree, or even dear old Santa Claus, which will entice all to come with the best wishes for the welfare of the school.

Should there be churches to hold the Christmas festivities, try a patriotic program a little later in the year. The American people will always respond to exercises in honor of "The Father of His Country." It is well to have a George and Martha with a few of their bewigged and powdered friends. A red, white and blue, or a flag drill is appreciated. Potted cherry trees can easily be had for decorations by hanging water-colored umbrella berries on orange or other tree branches. Invitations should be gay with flags or cherries. Hatchet souvenirs may be made by the pupils for the guests to wear.

Do you lack room for pupils and patrons? Let the guests be seated while the pupils remain on the playground until they march in and continue standing during the brief program. Then they may be dismissed while the parents, after a short intermission, listen to a lecture and later partake of colonial tea served by Martha and assistants in an adjoining room.

Many festal occasions may be held in the open in our lovely climate. Arbor Day for instance. Let the children bank up against the building and sing a few songs, have one or two short talks by prominent citizens, then the tree planting.

What can be of more interest than an out-of-door May festival? Butterfly invitations will attract attention, then, too, the children practicing winding the May pole will arouse the curiosity of passers by. Have the pole on the shady side of the building, also a throne for the May Queen. There is an abundance of flowers for the girls' wreaths and sprigs of green for the boys' coat lapels. The queen should be arrayed in flowers, while the younger pupils may be dressed to represent fairies, birds and bees.

Did I mention birds? Perhaps you prefer to save them for your Bird Day celebration. They are establishing such a day for the Arizona schools. In some states they have an annual bird house contest, when many prizes are offered the boys for the best built bird houses. Many teachers have difficulty in finding places for a few of the larger boys on these gala occasions. These boys often enjoy being ushers. Bows of color on the arm to represent the spirit of the day will assist in making courteous and important ushers.

The girls enjoy serving the refreshments. It is sometimes advisable to let the children bring the material, eggs, cream, butter, nuts and fruits from home, to make the cookies, wafers or pies.

The pie reminds me that the pie and tie socials seem quite popular at present.

Did I hear some one say, "You have simply told us about mere social affairs, but what about interesting the community in our real school work?" Yes, social affairs they may be, but they will bring the people to your school and when once the patrons come in touch with the enthusiasm of a live teacher and her boys and girls working for a common good, they will catch the spirit, visit the school, and be willing to talk over the most humdrum of school subjects with you.

Some teachers have a visiting day, when the parents are sent special invitations to visit the various rooms to observe the regular recitations. Others send home Mary or Johnny's best written work from time to time, while some have an exhibit near the close of school, displaying not only the manual training and domestic science products, but the academic work as well. There is, too, the extension agent sent out from the university who is going to be a great factor in helping us to interest the community in our school work. If Mrs. Salisbury and Mr. Parke have not yet visited your school try to secure appointments. Mr. Parke will perhaps appreciate your sending out Pig Invitations for his lecture.

The other day I heard a young teacher remark, "That social and club work isn't our work." Therefore, I wish to leave this thought with you. The teacher, if a true educator, does not merely try to instruct the pupils in her charge, but reaches out and tries to interest the community in the good, the right, the true, believing with Ruskin that: "The entire object of true education is to make people not merely do right things but to enjoy right things; not merely industrious but to love industry; not merely learned, but to love learning; not merely honest, but to hunger and thirst after honesty."

BOYS' AND GIRLS' CLUBS

(Summary)

BY L. S. PARKE, STATE CLUB AGENT, UNIVERSITY OF ARIZONA

Boys' and Girls' Club work is a national wide movement carried on by the United States Department of Agriculture co-operating with the various colleges and universities. At the present there are about 300,000 boys and girls enrolled. Various lines of constructive work are taken up; principally in the field of home economics and agriculture. In Arizona the boys and girls are offered enrollment in the following lines of work: Corn, cotton, grain, sorghum, pig, poultry and canning. My pictures illustrated the different phases of these activities.

The boys and girls are generally banded together as a club, at least five members being needed to form a club. The eligible age is between 10 and 19. Every club should have a club leader, some older person who will have the time to meet with the club at least once a month and who will look after the interests of the club in a general way throughout the period of the contest. The contests generally start in the spring of the year and continue through until December 1st. The club members are required to keep a careful record of work done so that at the end of the contest they can turn in a complete report showing the amount of work done and the actual profit made.

The winners of the contests are usually awarded prizes. This year over \$450 has been contributed from different sources in order to encourage this work among the young people.

CONSERVATION OF THE CHILD

(Outline)

BY DR. MARY L. NEFF

The vast disparity in natural endowment.

The helping of the poorly endowed child.

The need of protection for the defective child.

The relation between mental defect and crime, prostitution, and pauperism.

Vocational guidance.

The school the logical place for children to be studied and classified.

INTERSCHOLASTIC RELATIONS

BY PRINCIPAL E. A. ROW, TEMPE HIGH SCHOOL

In the process of establishing a community or settlement of people in any locality, one of the very first steps thought necessary is the organization of some community center, a church and a school, some form of local government which is nothing more than an organization of individuals for mutual self-protection and betterment. Our ideals of any group of individuals working together for practically the same ends without such organization or center would be very low indeed. This is the common plan of life, whether the members be individuals or groups of individuals, and it is one of the factors in all lines of activity and all forms of our institutional life. We are primarily interested in the organization of our school work and especially now in the relationships of the schools which are, after all, the individuals of the larger organization. Our question then is, what should be the extent of our relations with another school from the scholastic standpoint? Of what should these relations consist and how may we expect to benefit from them? We are interested in these relations in two ways or from two standpoints; first, from the standpoint of the individual student, and second, from the standpoint of the school as an organization.

I believe that our interscholastic relations, in the broad sense of the organization, have only begun to grow, and that they should develop extensively soon. They will develop rapidly when once there comes to be a solid foundation for an Arizona system of education. When once this is worked out, then and then only can our system of interscholastic relations be worked. The very newness of the state itself, and the wide area from which our teachers come, and the consequent diversified ideals which they bring are sufficient proof of the above statement. Here where the foundations of a commonwealth are being tested, where a school system is rapidly being built up and changes being made frequently, we need, as is needed nowhere else, co-operation and co-ordination. Conditions are more or less new to us and lines of thought regarding our individual subjects are subject to change. Where they should be changed, a direct knowledge of the treatment of kindred subjects in an institution that has kindred problems is beneficial. We need to get together in such a way that the good things of another school will be featured. I fear that our interscholastic relations have not been such that the best has been praised. Our relations should give student and teacher a better knowledge of conditions, and ways of better accomplishing

things after fully understanding the particular problems. Too often, I believe, we assume the attitude of the Irishman who, with a friend one day, visited the zoo. In walking about they came presently to the kangaroo cage. Pat, seeing the animal first, exclaimed, "Faith, and what is that?" Mike read from the letters on the cage, "A native of Australia." Pat's eyes bulged and he exclaimed in great frenzy, "Holy murder, a native of Australia, and me old mother just wrote me yesterday that me sister was married to a native of Australia; and to think of me being a brother-in-law to the likes of that. Faith, and what will the children look like."

As said before, I hope for interscholastic relations that will, with understanding, point out to us the good things of our institutions, and that will not make us see the inferior things, at least until they have been studied; relations that will make us co-ordinate parts of a great system, and not integral parts fighting to elevate self and lower opponents in the sight of our community and of the larger group of which we are members.

We have had interscholastic relations in a sort of haphazard way, along the line of contests. The end in view has been chiefly to win. The trend of contests has been toward the physical, and little has been done toward giving us a better understanding of our several mental attainments. This has been a means of much good, both to the individual competing and for the schools which are represented, but like everything else can be overdone, and does not accomplish everything that is desired.

There are a number of ways in which beginnings have been made in approaching the higher ideals of interscholastic relations. With one exception, however, they have been only beginnings, as they have not been developed.

One of the first of these to be used extensively was the idea of a visiting day for teachers. So often, especially from young teachers, do we hear this cry, "How do I know that I am teaching this subject properly? I never saw anyone teach it nor do I often get a chance to talk with anyone who does teach it." We say to our mechanically-turned boys, "Work with some one who knows this task thoroughly, as a part of your education." The successful business man is invariably the man who, as we say, knows the business from the ground up. That is, he has studied all of the branches of the business as an employe until he is able to meet the problems himself. Yet we have, no doubt in this assemblage, several teachers who have not as teachers seen lessons taught in the subjects which they are teaching. If I have fallen into a rut or have been negligent

along certain lines, it will probably become apparent, at least, on a visit to some live teacher in my subject. I am bound, therefore, not only to gain new ideas but to have a respect and better feeling for my colleagues in another school.

Along the same line as this the idea of exchanging teachers for a month at a time is gaining ground. In that case the good features are brought directly to the student instead of indirectly through the teacher. The teacher thus gets an opportunity to study more in detail the organization of his neighboring school, and to compare it with his own. The classes are also aroused and interested by new methods and new ideas. It surely will help to correlate our work and standardize our efforts. The plan has been carried out thus far only in our larger colleges and universities, but is being extended downward through the smaller colleges, and in due time will be used to some extent, at least, in our high school work.

I remember well an interesting plan which I saw tried years ago in two country schools. These were only two miles apart, and for some reason or other an enmity had grown up that was the cause of real distress. Bare fists played an important part in many a meeting on the road. Local entertainments were never complete without a scrap between representatives of the two schools. One day we were told by our teacher that on a certain day, soon, we would go to visit the other school. Much amazement, but at noon of the appointed day we started down the railroad, and arrived soon after the noon intermission. We were given seats and the recitations went ahead as usual for about half the afternoon. After a short recess a program of recitations and songs was given by the home school. The thing which surprised us, and even yet stands out prominently in my mind, was the fact that in that school they were doing precisely the same kind of work that we were doing and in practically the same way. The visit was returned a few weeks later, and the general effect was a decided improvement in the relations of these schools. The plan, of course, would not be practical everywhere, but there might be cases where it could be used to advantage even in the high school.

In the line of contests we have first of all, oratory and debating. These contests have not been developed as the athletic contests have, or at least the attitude toward them has not become so enthusiastic. To those participating they offer much good training, but those who participate are necessarily so few that from the standpoint of the individuals it does not mean much for interscholastic relations. These contests, though, may easily be made the basis for the organization of

debating and literary societies, and thus indirectly affect a much larger group of students. As far as the relations of the schools as an organization are concerned, it seems to be for the good, for the spirit shown by the contestants is, I believe, on the average cleaner than that shown in almost any other line of contests. That is partially due to the fact that few participate, but more due to the higher intellectual attainment usually required. In that very thing, I believe, the value of oratory and debating lies.

Typewriting and shorthand contests have not had much popularity as yet, probably because in a greater part of the country these subjects are comparatively new and the courses not definitely outlined. A few years ago, previous to the institution of University Week, these contests were held quite frequently in our part of the state. They were made the occasion for quite a little activity, great crowds often going from one school to another for the evening. The old slogan of "Win at any cost" became fairly well developed and soon the contests were discontinued. The instructors felt that the good which came to the individual student did not warrant the great amount of extra time taken away from the whole class to help that student. They have been unwilling to sacrifice the general development of the class to the one "shark" of the class. There is another element in these kinds of contests that I believe enters largely into determining whether or not they are to be popular, and that is the very nature of the subject matter and the method of teaching it. The work is so given that each student knows every day just how far advanced he is, and where he stands in his class. He contests with his classmates to write thirty, forty, or a hundred words per minute with a minimum of errors. Commercial and business organizations who have been back of these courses have treated them as contest courses, and have offered medals, prizes, and certificates for a certain proficiency. This has been sufficient to give all the incentive and interest that is necessary for the student, and has eliminated the going about from school to school to contest. I do not believe that this type of contest has much to offer for the benefit of the individual student, nor for the benefit of the school as an organization. Therefore, it does not seem to me that it will become popular.

I come now to that most common of our interscholastic relations, and that which is ninety per cent. of the reason for the several high schools of the state sending a portion of their student body here this week. I refer, of course, to athletics. Above all other types of relations it is developed, and being thus highly developed and common everywhere it is that much more subject to criticism, both favorable

and adverse. I believe, honestly, that our athletics are being overdone, that the physical and mental strain of, "Win at any cost," requiring weeks and months of strenuous preparation, should not go hand in hand with the high school age, which is essentially an adolescent age. There is too much of a tendency among our high school boys and girls to ape their older brothers and sisters in the university. This is shown in the tendency toward fraternal organizations and social functions with the snobbery of exclusiveness and the deteriorating influences of late hours, as well as in the athletics. The college boy is past the growing period, which is the danger period, and is more nearly ready for a rigorous system of training. Statistics show that from five to ten per cent. of the Freshmen entering the University of Wisconsin have enlarged hearts with dilation attributable to athletic sports. This not only keeps these students out of the college sports, but to some extent, at least, hampers their scholastic work. Such a sacrifice might be called for to save the honor of our country, but should not be necessary to save the honor of one's school. I am not opposed to physical exercise and mild and well timed athletic contests, which will tend to relieve the monotony of school life and freshen mind and body, but I am opposed to that long, tedious training and self-denial, requiring great physical exertion and mental tension, at a time in life when the body is most susceptible to injury.

There is still another tendency of our present day athletics, hinted at some minutes ago, which I believe is from no standpoint commendable. The keener the rivalry that exists between two schools, the greater the temptation to make ammunition out of a neighbor's weakness, and thus while our teams fight for the honor of their school, they fight for the downfall of an inferior group which dares oppose them. It is impossible for a man to be taller than a boy and both be the same height. So it is next to impossible for a team to contest for the honor of the school, and at the same time keep an equally high respect for the honor of the opposing school. I believe that it is a legitimate criticism of our present day athletics to say that they tend to call the attention of our students to the weak features of another school, rather than to the strong ones. In this respect athletics are failing to do that very thing which their sponsors have claimed for them, to develop a manliness and physical and mental control of self. The physical welfare, of course, is a claimant for consideration, and rightly so, too. That, however, may be accomplished in a well equipped gymnasium with a competent instructor, and it would do the good where it is most needed, which our present system of athletics emphatically does not do.

I was once a student under a professor of mathematics who had grown gray in the service of his school, and whose students were never excused to take part in any interscholastic contest. He frequently made the statement that the only safe way to handle interscholastic athletics was to have a paid corps of men, who had no other duties in connection with the school, to do the contesting. His views at that time seemed most extreme, but now, as a teacher, they seem much less severe.

Recently I heard a humorist recite a poem, the words of which I cannot repeat, but the thought ran something like this: A football team comes on the field bright and fine in new uniforms. The fair co-ed in the bleachers bubbling over with admiration vents herself of "Rah! Rah! Rah! Varsity!" The game begins and the toiling, sweating mass plies back and forth until a man knocked out is carried from the field. The cry comes "Rah! Rah! Rah! Varsity." The game goes on. Another player dragged out from the bottom of the mass is carried off with a broken arm, a smashed nose, etc. Still comes the cry "Rah! Rah! Rah! Varsity!" Every man on the team suffers, is bleeding, and is defeated. With a harsh word for the opposing team still comes the cry, "Rah! Rah! Rah! Varsity!"

Is it possible that we have been so carried away by the mighty spirit of contest, with its "win or die" slogan for the honor of the school, that we have failed utterly to look down at the foundations to see the grim sacrifice that is being made in order to gain a reputation as a victor?

You no doubt will not believe me now as I say that I am not trying to deprecate interscholastic athletics. What I am trying to do is to point out just a few of the dangers, with which an ever growing and keener sense of rivalry has brought us face to face.

I have tried to enumerate herein the various kinds of interscholastic relations, and to go more or less into detail with that form which is most common, discussing it both as to its effect upon the individual and its effect upon the school as an organization. I have purposely assumed a somewhat critical attitude toward our present day athletics with the idea that it may provoke some discussion or, at least, some thought on the subject.

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SAFETY SERIES No. 17

APRIL 3, 1917

J. OGDEN ARMOUR ON ENTHUSIASM

Enthusiasm is the subject taken by J. Ogden Armour this month in his discussion of topics vital to the welfare and progress of his employees. Mr. Armour is the author of many helpful articles which appear in the Armour magazine, a monthly publication for the employees of the firm. This month's article contains sound advice and should give much food for thought to the thousands of men and women in the employ of the company.

The article follows:

"Enthusiasm is the dynamics of your personality. Without it, whatever abilities you may possess lie dormant; and it is safe to say that nearly every man has more latent power than he ever learns to use. You may have knowledge, sound judgment, good reasoning faculties; but no one—not even yourself—will know it, until you discover how to put your heart into thought and action.

"A wonderful thing is this quality which we call enthusiasm. It is too often underrated as so much surplus and useless display of feeling, lacking in real substantiality. This is an enormous mistake. You can't go wrong in applying all the genuine enthusiasm that you can stir up within you; for it is the power that moves the world. There is nothing comparable to it, in the things which it can accomplish.

"We can cut through the hardest rocks with a diamond drill and melt steel rails with a flame. We can tunnel through mountains and make our way through any sort of physical obstruction. We can checkmate and divert the very laws of nature, by our science.

But there is no power in the world that can cut through another man's mental opposition, except persuasion. And persuasion is reason plus enthusiasm, with the emphasis on enthusiasm.

"Enthusiasm is the art of high persuasion.

"And did you ever stop to think that your progress is commensurate with your ability to move the minds of other people? If you are a salesman this is preeminently so. Even if you are a clerk, it is the zest which you put into your work that enkindles an appreciation in the mind of your employer.

"You have a good idea—don't think that other people will recog-

nize it at once. Columbus had a good idea, but he didn't get 'across' with it without much of this high persuasion.

"If you would like to be a power among men, cultivate enthusiasm. People will like you better for it; you will escape the dull routine of a mechanical existence and you will make headway wherever you are. It cannot be otherwise, for this is the law of human life. Put your soul into your work and not only will you find it pleasanter every hour of the day, but people will believe in you just as they believe in electricity when they get into touch with a dynamo.

"And remember this—there is no secret about this 'gift' of enthusiasm. It is the sure reward of deep, honest thought and hard, persistent labor.

"J. OGDEN ARMOUR."

*Teach the new man how to avoid accidents.
He may have a wife and family who love him.*

HEALTH INSURANCE

LEGISLATION ADOPTED IN COUNTRIES OF OLD WORLD BEING DISCUSSED FOR AMERICA

Health insurance for wage earners will soon become a matter for American legislation as it is now in Canada and in several countries of the Old World. Six European countries have adopted compulsory health insurance already and so successfully has the measure worked benefits to the people that every civilized industrial country in the Old World, with a few exceptions, is now confronted with this new type of social legislation.

Among the benefits derived from this system of health insurance has been noticed a check upon the increase of degenerative diseases among wage earners of middle life. Health insurance brings medical care within the reach of large numbers who are unable to afford this luxury on the present basis of payment. Medical care is paid for in advance on an insurance basis, calling for only small weekly contributions. Such conditions encourage wage earners to seek medical advice and treatment when suspicious symptoms occur, and do not defer till treatment and cure are not to be had.

Health insurance has universally proved a promising weapon with which to fight the premature diseases of adult life.

*Acquire the safety habit. It is a habit that
will never injure you.*

WHAT TO DO AT ONCE WHEN A FELLOW MINER IS HURT

Be calm and remain so.

If he is under a fall and you can not move him, go for help.

Send for the boss; send for the First Aid team and First Aid supplies; send for the stretcher; see that the doctor is called.

Take charge and give orders until the boss comes.

Find where the man is hurt before trying to move him. If you believe that a bone is broken or there is a wound or that hemorrhage has started, remove the clothing over the part injured to make your examination.

Don't try to pull off clothing; cut or rip clothes if they must be taken off.

If his back is hurt, *don't move him* until you have help or the doctor comes.

Always place the injured man on his back, with his head lower than the rest of his body (unless he is bleeding freely about the head); open his collar and loosen his belt.

Always look for bleeding, and if the blood is bright red and coming in spurts, try to stop it at once.

Don't give an injured man brandy or whisky or any stimulants while he is bleeding; keep him quiet and warm.

If any bones are broken, put on splints before moving him. If you are in doubt as to whether the bones are broken, always put on splints.

If you find that he has no broken bones and is not bleeding or spitting blood, but is very pale and is cold and breathes fast, *keep him quiet*; lay him on his back, lower his head, cover him with brattice cloth, clothing, blankets, or the like; place safety lamps, if they are used in the mine, under covers near him as an aid in keeping him warm; do not let others crowd around him, but give him plenty of air.

Malaria is spread by a special mosquito.

SAFETY FIRST IN BLASTING

We believe that all employers of labor try to exercise reasonable care to prevent accidents to their men. Ordinary instincts of humanity, if nothing more, would dictate such a policy.

In the state of Pennsylvania now there are additional reasons why employers should be particularly careful to avoid accidents. The

new Compensation Law makes the adoption of safety features more imperative in that state than ever before.

We feel that a few suggestions to employers in lines of work that call for the use of explosives will be particularly apropos at this time:

1. Use low-freezing extra dynamites wherever possible in preference to the high-freezing straight dynamites. They are safer because they are less sensitive to accidental shocks, and seldom require thawing. In addition, they are considerably cheaper.

2. Adopt electrical blasting methods wherever possible in preference to fuse and blasting cap method. The principal object of this is to prevent hangfires and misfires, which are always dangerous to workmen.

3. The use of blasting machines in blasting operations makes it unnecessary to have matches on the job. The advantage of this is obvious.

4. Every blasting operation should have a galvanometer for testing blasting circuits and a rheostat as a part of the equipment. These useful little pieces of apparatus eliminate the guessing, which is always expensive and entails risk of life.

5. When thawing is necessary, use standard thawing kettles or thawing house equipment instead of permitting employees to soak frozen dynamite in warm water, or to heat it in ovens, or to thaw it by standing it around an open fire. All of these practices are dangerous.

6. Magazines should be kept clean and dry. Sand, nails, or other foreign substances on floors may cause explosions and result in loss of life.

7. Magazines should be properly located to comply with the American table of distances.

8. Dynamite and blasting supplies should be kept separate until they are ready to be loaded into bore holes.

Compliance with the above simple suggestion may save a good many lives and render employers immune from damages under the new Pennsylvania Compensation Law, and what is good for Pennsylvania is good for any other state, even if it doesn't happen to have a Compensation Law.—DU PONT MAGAZINE, Wilmington, Del.

Don't waste money for patent medicines and advertised "cure-alls." They are of value only to those who sell them.

WOOD ALCOHOL—A DANGEROUS POISON

BY ROBERT ANSLEY, M. D.

All cans or other receptacles containing wood alcohol should be labeled "Wood Alcohol—Poison," and kept locked up so that no one can meddle with same or drink same by mistake.

When using wood alcohol to clean electrical apparatus or for mixing shellac, paint or for any other purpose, care should be taken to have good ventilation, as the fumes are just as dangerous as the fluid.

The symptoms of wood alcohol poisoning are hoarseness, headache, ringing in the ears, trembling, difficult breathing, nausea, convulsive twitching of muscles, impairment of sight. Severe cases suffer from weakness of the heart, delirium, coma and after consciousness is recovered more or less permanent complete blindness.

It is recommended that wherever possible denatured alcohol be used instead of wood alcohol.

Guards are placed on machinery for your protection. Don't operate the machinery unless guards are in place.

DANGERS IN REFORMING SAFETY CONDITIONS

In the pursuit of reform in conditions at mines, as elsewhere, there is the danger of going too far. The extremist for profit will view mine-safety expenditures with an eye to immediate costs of installation and operation, whereas the idealist will urge such a refinement of methods, such a thorough protection, and so wide-reaching a paternalism as will be unjust and as well instill too great confidence in the minds of the operative, and therefore produce carelessness. It is unnecessary to argue that there are inherent and unavoidable risks in industry. The fact is recognized by all except a very few unreasoning enthusiasts. Any system of safeguarding employees that minimizes their sense of personal responsibility tends to increase casualties. Many employers hold that safety precautions may be carried so far that this sense of personal obligation will not only be diminished, but that it will be entirely destroyed. The responsibility for preventable accidents lies, not with the employer alone, but with the employee as well. Both usually suffer through careless acts. No sentimental considerations, no effort to take a position where there can be no criticism of his zeal for safety, should cause one to forget that both parties are accountable and that they have duties equally important and

urgent. Many employers of mine labor in the Lake Superior region have taken every reasonable precaution to safeguard mines and machinery, and their study has been extensive along the lines of the improvement of safety devices and the formulation of safety rules, in the light of actual daily practice. Sentimentality must not obscure the fact that carelessness, recklessness, and a disregard for orders put the workman in the class of the employer who makes no provision for safety but carries forward his operations with no attention to the obligation due his fellow men. Not only does the careless laborer imperil himself, but he endangers his fellows as well, and he may frequently nullify every appliance, device, and rule, upon which his employer may have expended great sums of money, much time, and anxious thought. Strict discipline is one of the requirements of the situation, for only by obedience and co-operation can the utmost good be obtained from expenditures for safety.—U. S. BUREAU OF MINES.

Abundant fresh air will prevent more disease than will unlimited medicine.

THREEFOLD BENEFIT OF HEALTH INSURANCE

Wherever health insurance for workmen has been in operation it is agreed that the cost should be distributed among employers, employees, and the state, or government, for all three are beneficiaries.

An employer may ask: "How am I benefitted by having my employees insured to receive help when sick?" The answer is that it is profitable to him to maintain and improve the health of his workmen. This is true of the employer as a class. The employer would not pay the cost from his own pocket, but would transfer the expense to the industry, and this would be fair because the industry is the cause of the greater part of the sickness of workmen. Many employers, particularly railroads and steel plants, recognize this by maintaining a sickness insurance fund, withholding from each man's pay a small per cent for the cost. Also, many employers, like railroads, maintain hospitals for their employees. All of this would be standardized and made universal by a compulsory system of health insurance. The employer would then have a new motive for safeguarding the health of his workers. He would have an added reason for keeping his shop safe and clean. He would be more than repaid by the increased efficiency of his employees, which would follow naturally their better condition of health.—KANSAS CITY (Mo.) TIMES.

SAFETY APPLIANCES

It is hardly necessary to refer to the objective of safety appliances. The state, in its mature judgment, as voiced by its legislature, has seen fit to make certain requisitions on employers operating hazardous industries. It has imposed obligations on the board to see that these requisitions are met. Safety appliances, wherever possible, must be installed. The state's interest in this subject is ostensibly one of economic value, yet everyone knows, who has given public movements a moment's thought, that back of every law like this is the sentiment of humanity dwelling in the public heart. To protect human life and guard against injury to body and limb are cardinal elements in human life itself. The necessity for collective co-operation is so urgent and appalling in this age of tremendous operations that the individual is being looked after by the public. The body politic, which has heretofore been considered an individual without soul or sentiment, has developed into an entity possessing all these attributes which distinguish man from the brute creation. Therefore, the public in the great industrial work is solicitous regarding the safety of its individual. It goes with him into the mines and insists that rational conditions must be maintained; that avenues of escape must be provided for in case of unexpected calamity. It accompanies him to the mill, smelter, workshops and logging camps, and waits until safety appliances are installed to guard the thoughtless and unwary from the exposed belts, shaftings, gearings, pulleys, saws and protruding set screws.—(MONT. IND. ACCIDENT BOARD REPT.)

*Health is not put up in bottles, neither can
it be bought at the corner drug store.*

SAFETY SLIDES FOR TRAM CARS

In loading cars from chutes, chunks frequently roll off from the top of the car, especially when the car is almost full or when there is a sudden rush of muck through the chute. It is at this time that the man loading the car receives a badly injured foot or, in an effort to protect his foot, tries to hold the chunks on the car, and the result is a badly bruised hand. By having safety boards six or seven inches above the top of the car, which boards are removable, being placed in cleats on the side of the car, it will prevent the chunks from rolling off the car and injuring the man. Such boards may be easily removed when the car is full.

AT THE OLD DOMINION

The Old Dominion has worked their First Aid and Safety work into a social organization and in so doing has stimulated great interest in the work.

The First Aid and Safety smoker, which was given at the Old Dominion library in Globe recently, was one of the greatest efforts in the history of the Old Dominion First Aid organization. Director Orr Woodburn states that the International smelter at Miami has contributed several numbers to the entertainment in appreciation of the courtesies extended their men in First Aid training. The program for the evening, in part, follows:

Three-round boxing contest, Gampp vs. Frazier; monologue, B. V. von Seden; xylophone selection, Franke and partner; bag-punching exhibition, International smelter number; saxophone solo, Eli Banfield; mine safety slides with remarks by Steve Tillman; Swede impersonation, Ed. Martinson; three-round boxing contest, International smelter number; vocal solo, C. A. Clark; wrestling match, Tony Ajax and partner.

*Peelings on the sidewalk, apple cores and all,
Kick them in the gutter, save someone a fall.*

BEING CAREFUL FIRST

Senator Weeks, of Massachusetts, smiled the other evening when reference at a dinner was made to the question of caution. He said he was reminded of an incident along that line.

Some time ago Uncle Josh had to go to the city and his business keeping him away from home over night he stacked up against the unfamiliar procedure of hiring a room in a hotel. Having expressed his wants he was about to leave the desk when the rather pert clerk called him back.

"Well, what is it?" responded Uncle Josh, retracing his steps. "Have I fergot somethin'?"

"Sign your name here," said the clerk, peremptorily pointing to the registry. "Other guests would like to register."

"See here, young feller," said the farmer, assuming a leisurely attitude, "don't ye try ter hurry me. I don't sign nothin' that I hain't read over fust."—EVENING TELEGRAPH.

*Morning eye opener—a pint of water inside.
Did booze ever do you any good?*

REWARDS FOR SAFETY WORK

Various plans have been tried to interest the individual workman in his own safety. It is very easy to excite his curiosity or cupidity and appeal to family ties is effective for a time, but it requires patience and perserverance on the part of the foreman and superintendent to keep the men steadily up to the safety standards set for the shop.

A circular letter distributed to the employees of one of our members offers rewards in the shape of extra pay or time off to the men and bonuses to the foremen. Every month the department having the best record is given time off or extra pay equivalent to sixteen hours time and foremen receive a bonus of 5 per cent of their monthly wages.

The plan is an excellent one and the rewards offered are very liberal when one considers that the only object sought is the safety of the men themselves. Strange as it may seem, the complaint of the workman of a decade ago has been turned squarely against him. Then it was the cry that the "Boss didn't care." Today the "boss" can say with just as great measure of justice, perhaps, that the men "Don't care."

As a matter of fact both "care," but because of our lack of public demonstration we haven't made each other fully understand—that is where the reward for safety work bridges the impersonal.

Every plant can well afford to try out some modified plan of extra inducement to secure high standards of safety work.

Bullets may kill thousands—flies tens of thousands.

BYGONE MEMORIES

Philip is an amateur artist who raves about nature. One day he was giving all his attention to a painting of a sunset of lurid red, with blue streaks and green dots. An old rustic crossed the meadow and stopped behind him at a respectful distance.

"Ah," said Philip, looking up at the old farmer suddenly, "perhaps to you, too, nature has opened her sky pictures, page by page. Have you seen the lambent flame of dawn leaping across the livid east; the red-stained, sulphurous islets floating in the lake of fire in the west; the ragged clouds at midnight, black as a raven's wing, blotting out the shuddering moon?"

"Well, no," said the rustic; "not since I give up drink."

WHEN IS A MAN DRUNK?

No one with any education whatever will attempt to justify the use of alcohol "*in excess*." Many men of good education, and in other respects sane and sensible, persist in the belief that "*moderate drinking*" does no harm, or even produces beneficial results to health or happiness. When asked to define "*moderate drinking*," the greater number of really temperate men will say: "O, an occasional cocktail, or a glass of beer."

Recently scientists made extensive and exhaustive tests, on a large number of people, as to the physical and mental results produced by the use of one average sized cocktail per day, or its equivalent in alcohol in other beverages. The result showed that this amount of alcohol per day will set you back about 7 per cent in muscular endurance and about 15 per cent in your ability to remember things. So that in reality a man is drunk after he has had one drink.

If you are one of the "*moderate drinkers*," who have deluded yourself with the idea that you were doing yourself no harm by your "*moderate drinking*," you should read the report of these experiments, under the above title, in the American Magazine for April.

If you are a teetotaler, the reading of the article will give you additional arguments.

*The full dinner pail—the open window—
the clean well—make for health.*

TYPHOID FEVER

It is now known that typhoid fever is caused by germs. Germs are tiny things so small that they can not be seen with the naked eye. Hookworms are plainly visible; germs are not. The smallness of typhoid-fever germs can be realized from the fact that 36,000 of them placed side by side make a line only 1 inch long. If we did not know their ways it would be practically impossible to protect ourselves from such invisible foes. It is now known that typhoid germs leave the body with the bowel discharges. This is true not only of sick people, but also of those who are "coming down" with sickness or of those who are convalescent. More serious still, recent investigations have shown that persons who are seemingly well discharge disease germs. Such persons are known as "carriers." The only safe protection is to shun contact, direct or indirect, with all human excrement, because that is the source through which the disease typhoid is communicated. Each case of typhoid fever cries out that this fundamental law of cleanliness has been violated.

GOOD BOOKS

- FIRST AID IN ILLNESS AND INJURY**—*Lynch, Charles, and Shields, M. J.* American Red Cross Abridged Text-Book on First Aid: Industrial edition. Phila., P. Blakiston's Son & Co., 1916. 175 pp. illus. Paper, 30 cents.

A small text-book prepared for and indorsed by the American Red Cross, which treats of first aid subjects of interest to the worker in the industrial field. This manual is issued in various editions, namely: Miners' edition, Railroad edition, Woman's edition, and others. Certain facts which are necessary to all workers in first aid are included in each edition, but the specific facts applying only to special classes are given in the edition for which that information is most useful, i.e., First aid treatment for accidents peculiar to miners will be found in the Miners' edition; to railroad men, in the Railroad edition; to the home, in the Woman's edition. The volumes are indexed for ready reference.

- HEALTH SERVICE**—*Ritchie, John Woodside.* Primer of Sanitation. Yonkers-on-Hudson, New York, World Book Co., 1915. 216 pp. illus. List price, 50 cents; mailing price 60 cents.

Presents the principles of sanitation and the essentials of public hygiene in a clear, well-arranged text for children. Through graphic illustrations and practical suggestions which any child can understand, it aims to teach children how to escape germ diseases and how to co-operate in conserving community health.

- INDUSTRIAL INSURANCE**—*Henderson, Charles Richmond.* Industrial Insurance in the United States, Ed. 2. Chicago, University of Chicago Press, 1911. 454 pp. \$2.

A general survey of the different systems of workmen's insurance in the United States. The book is an accumulation of information as to what is actually being done by various societies, states and firms throughout the country. A summary of European laws on industrial insurance prefaces the work to indicate the various tendencies of thought and activity in this field. The appendices supply a bibliography and texts of important laws, contracts, constitutions and reports.

- PROFIT SHARING**—*Williams, Aneurin.* Co-Partnership and Profit Sharing. (Home university library of modern knowledge.) New York, Henry Holt & Co., 1913. 256 pp. 50 cents.

A clear exposition of the principles of the subject and a description of selected types in England, France and the United States. The

author has devoted twenty years to the direction of co-partnership in Great Britain and has high hopes for its attainments. Written from the employer's standpoint.

WORKMEN'S COMPENSATION—*Campbell, Gilbert Lewis*. Industrial Accidents and Their Compensation. (Hart Schaffner & Marx Prize Essays.) Boston, Houghton Mifflin Co., 1911. 105 pp. \$1.

A brief but thorough study, chiefly concerned with American aspects of the question. Contents: Statistics of industrial accidents; social cost of industrial accidents; voluntary agencies compensating industrial accidents; employers' liability in the United States; employers' liability insurance. The concluding chapter gives the principal provisions of employers' liability laws in Europe and suggestions for their adaptation to the problem in America.

A clean mouth is essential to good health.

THE PUT-IT-OFFS

My Friends, have you heard of the town of Yawn,
On the bnaks of the River Slow,
Where blooms the Wait-awhile flower fair,
Where the Sometime-or-other scents the air,
And the soft Go-easys grow?

It lies in the valley of What's-the-use,
In the Province of Let-'er-slide;
That tired feeling is native there,
It's the home of the listless I-don't-care,
Where the Put-it-offs abide.

The Put-it-offs smile when asked to work,
And say they will do it tomorrow;
And so they delay from day unto day,
Till death cycles up and takes them away
And their families starve, beg or borrow.

—ANONYMOUS.

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SAFETY SERIES No. 18

MAY 1, 1917

CORPORATION INSURES EMPLOYEES

Probably one of the most important steps ever taken by one of the great mining corporations of the country is that of the American Smelting & Refining Co. in the insuring of their employees. With the knowledge that if anything should happen to the workman, provision will be made for his family, he will enjoy a peace of mind and freedom from worry which he would not otherwise enjoy, and would enable him to render even better service and do it more cheerfully. The following notice sent out by the American Smelting & Refining Co. gives the details of the plan:

"The Consolidated Kansas City Smelting and Refining Company in further development of its policy in matters relating to labor and welfare, has adopted the following plan of Group Life Indemnity for the benefit of its workmen and their families or dependents:

"Effective as of January 1, 1917, the company at its own expense will issue to each wage-earner employed at any of its plants, mines or mills in the United States, who has been in the service of the company for one year or more, a certificate of indemnity paying, in the event of death for any cause while in the employ of the company, one thousand dollars (\$1,000) to the families or dependents of married men and five hundred dollars (\$500) to the dependents of single men. On the marriage of a single man, the amount of his indemnity will at once be increased to that of a married man. Persons in the employ of the company for less than a year will receive a certificate upon the completion of one year's service. Certificates will be issued without discrimination as to language or nationality, color or creed, irrespective of age, and without medical examination or other proof of physical condition. Payment will be made to the beneficiary designated by the employee, but if there be no designated beneficiary surviving at the death of the employee, payment will be made to (1) the widow; (2) if no widow, the children, equally; (3) if no child, the parents, equally; (4) if no parent, the brothers and sisters, equally; (5) if no brother or sister, the estate, in the order named, payment to a beneficiary first in order, excluding beneficiaries later in order. The indemnity will be paid in whole or part as soon as possible and

not more than thirty (30) days after satisfactory proof of death and identification of beneficiary. It will be paid in a lump sum or in not more than five installments, as in the judgment of the plant manager will prove the more advantageous to the beneficiary; but all installments shall be fully paid within twelve months after death. The term of the certificate will be one year, but at the end of each year, for the five years next ensuing, the intention of the company is to issue a new certificate, increasing the amount one hundred dollars (\$100) in the case of married men and fifty dollars (\$50) in the case of single men, to the end that the indemnity of married men will eventually be one thousand five hundred dollars (\$1,500) and the indemnity of single men seven hundred and fifty dollars (\$750). This indemnity is for employees of the company only, and will therefore cease in the case of any person leaving its employ for any cause.

"The motives which actuated the company in taking the action announced in this circular may be summarized as follows:

"The company regards itself as under obligation to its faithful and regular employees, who do its work and keep its operations going, in the same way that it is under an obligation to the stockholders whose savings and investments furnish the capital for its business. With regard to employees, the company is concerned with the welfare, not only of the men, but of their families. Its aim is, therefore, in addition to paying them a fair living wage, as high as prevailing labor conditions and the competitive nature of the industry will allow, to provide safe and suitable conditions for their employment, to promote their general health and well being, to furnish aid and relief in the case of sickness and accident, and to make provision for those growing old in the service. In furtherance of this aim, the company employs safety experts and engineers, installs safety devices, provides hospital care and medical service, administers workmen's benefit funds and maintains an old age pension system, all under the direction of a permanent labor and welfare department. In this way, while supplying the means of livelihood for them and their families, the company hopes also to spread a feeling of contentment among its workmen, to give them a sense of security in their employment, to earn their loyalty and confidence, and to give them sound reasons for believing that the company's interest is their interest, and thus promote a relation of mutual consideration productive of the best results for both employer and employee.

"The present action of the company in establishing a system of life indemnity for its workmen marks a further and important step in the same direction, and gives further evidence of the company's

appreciation of the individual needs of its employees and readiness to supply such needs in every feasible way. With this added proof of practical good-will before them, the company believes that its workmen will enjoy a peace of mind and freedom of worry which can only come with the knowledge that their families or dependents at their death will not be left in want. The company desires to cultivate a permanent force of employees, who will remain in its service from year to year, upon whose continued loyalty and industry it can rely, and who in turn can rely upon the company to protect their interests and reward their labors. The theory of the company is that whatever makes for a feeling of contentment and security among its workmen makes also for willingness and efficiency in their work, and gives rise to a permanent body of active and interested working aids.

"The indemnity in question will be carried by the company itself, with no charge to employees, and the cost will be taken up in the general expenses of each plant. In the case of those plants where group life insurance is now in effect under policies issued by an insurance company the policies will not be renewed on their expiration, and certificates of the company will be issued in lieu thereof.

"The certificates of indemnity above referred to will be issued as soon as the necessary details involved in the establishment of the system can be completed."

Caution and safety go hand in hand.

LUCK?

What is luck? It is the element of chance; and chance is the mother of circumstance. If a man is standing on the railroad track and he doesn't get off, and the train hits him—why they call that bad luck. If he does jump off, and the train misses him, why they call that good luck. One man walks right into a gambling house and lays his money down and loses it, and calls it bad luck. Another man walks into a savings bank and puts his money there and leaves it. They call him lucky. Forget that lucky stuff. You can waste enough time kicking about your bad luck, or in wondering why you don't have good luck to go out and get a job and be on Easy Street. You are your own luck—it's in your head.—R. F. OUTCALT.

A mule makes no headway while he is kicking. Neither does a man.

GARDENS

One advantage of living in many mining villages is that each house has a yard, so that a garden is possible. Many persons who live in large tenement houses in a crowded city would greatly appreciate the miner's yard.

Miners can get great pleasure and profit from their gardens. Fresh vegetables from one's own garden always have a better flavor than those bought at a store. Many of these vegetables can be stored for use during winter. The garden helps to reduce the cost of living.

Some interesting contests may be arranged in connection with gardens. In one mining village five miners got together and paid in \$2 each and this prize of \$10 was to be given to the one who had grown the heaviest tomato by a certain fixed date. The contest aroused so much interest that the following summer twenty miners joined the tomato club.

If a garden is started at the right time and cultivated in the proper way the work is not difficult. Fifteen or twenty minutes spent each evening among green growing things is restful for the miner who has spent the day in the mine, where all is black and where nothing grows. Days when there is no work at the mine may be spent with profit in the garden. Often these idle days are a burden, and the miner, simply because he has nothing better to occupy his time, spends these days in ways that do not pay.

The garden will keep the children out of mischief and teach them thrift and a knowledge of nature and her ways. It will furnish a healthful and pleasant diversion for the miner's wife and will be a means of getting her to spend more of her time out of doors in the pure air and sunshine.

A garden greatly improves the appearance of the yard. It banishes disorder. It shows up uncleanness by contrast. What a difference between an ugly, barren, dirty yard and one that has a neat, well-arranged flourishing garden! The garden and lawns help to make a cleaner house. They reduce the dust nuisance. This feature is important, as will be seen later on when pure air is discussed.

*In less than another generation there will
be a lot of good ragtime piano players and one-
steppers in the poor house.*

REPORT OF THE SECRETARY OF THE COMMITTEE ON SAFETY AND SANITATION

Discussion of the paper of E. Maltby Shipp, presented at the New York meeting, February, 1917, and printed in Bulletin No. 121, January 1917, pp. 87-122.

WALLACE MCKEEHAN, Douglas, Ariz. (Communication to the Secretary*).—In going over the report, which I have done very carefully, I find that the summary as composed deals with the various problems almost entirely from the employer's standpoint and that practically no consideration is given to the employee's point of view. Problems almost entirely from the employer's standpoint and that almost thirty years as workman and official, has convinced me that any plan for the betterment of working conditions which will achieve any degree of success must give the workmen their share of responsibility and allow them full participation. The company may finance and direct the movement, but its ultimate success depends upon the support given by the workmen. The co-operation of the men doing the actual work is so essential that all writers insist that this must be secured, but they do not agree as to how this can best be done.

I am convinced that the employer who, in starting an employees' welfare department puts the proposition up to his men as being strictly a good business deal for both, will secure results. While he who preaches of humanitarian motives, of doing all this for the good of the workmen and their families, at the same time using a paternal tone, will only cause the men to become suspicious. American workmen want no petting. All they ask is a fair deal all around.

Accident prevention and welfare work in general cannot be forced upon English-speaking employees, and the management who tries it will lose out; but a straight-forward, look-you-in-the-eye proposition, with all the cards on the table, will appeal to the men. Once they are convinced that they have an even break, they will sit in the game and raise your bid every time.

Too many welfare organizations are placed almost entirely in the hands of officials and bosses; especially are they in the majority upon the committees. This is not as it should be. In my opinion the workmen should constitute the majority upon all committees. If this is done, rarely will they abuse the privileges. Our experience would go to prove that workmen take more interest in accident prevention matters than the officials or bosses, and are quite quick to censure their fellows for infractions of rules. In proof of this I would state that of the many safety suggestion cards received by this department, only one was sent by a boss.

*Received February 1, 1917.

This *department receives many inquiries as to the best method of initiating and conducting a safety and welfare organization. The reply invariably sent is, "Do your part first; make all working conditions as safe, sanitary, and convenient as it is possible for you to do. After you have shown the men that your intentions are of the best, you are in a position where you can ask for their cooperation."

The work that can be done by companies engaged in mining, milling and metallurgical operations is, comparatively speaking, slight as regards the number of accidental injuries prevented, but the work done creates a good impression among the men.

While no fixed method can be advanced for the formation and conduct of an employees' welfare organization, if the cooperation of the workmen has been secured, the other problems may be quite easily worked out. All employees are naturally suspicious of the good intentions of their employers. One of the first things that the manager must do is to issue an order to all those in charge of operations, that safety must be the first consideration in the conduct of all work, and insist that this order be carried out to the letter. Most managers dislike to do this, because they fear it will interfere with the output. Such is not the case, however, as safe working conditions make for greater efficiency. All officials and sub-bosses must be made to understand that unsafe conditions, methods and practices will not be permitted. A good way to secure their cooperation is the paying of a bonus for a reduction of accidents; also a bonus for keeping their respective places clean, orderly and sanitary; this last to be cared for by a monthly inspection, preferably by a committee of employees. The Copper Queen Company pays its mine bosses a bonus of \$30 each. This is paid quarterly and is based on the least number of accidents per thousand shifts worked, ten bosses participating.

One thing that has caused the workmen to view with suspicion the formation of a welfare organization is that some companies have started the work with a great hurrah and then have let the movement quietly die. Although this practice has about died out, it will prove a severe handicap to future operations along welfare lines by these particular companies, to say nothing of its effect upon others.

The present tendency among safety inspectors is to have as few and as simple rules as possible. No rule should be allowed in the book that cannot be enforced. All rules should be couched in the terms and phraseology used by the workmen. For the above reasons,

*Mr. McKeehan is Safety Inspector with the Copper Queen Consolidated Mining Company.

the rules committee should include a number of good practical workmen. There are so many good rule books now in use that the rules committee can select sound rules that will cover the operations of practically all departments. These can easily be changed or amended to suit local conditions.

Strict observance of all rules must be insisted upon. To secure this, some form of discipline will be necessary. Just how this matter will be handled should be left to the workmen's safety committees. With our organization, a man who breaks a safety rule is reprimanded for the first offense; given a layoff of from 1 to 15 days for the second, and discharged for the third.

Both men and bosses must have a thorough knowledge of all rules. This is often a difficult thing to obtain, for with a large employing company a personal examination cannot be made of each individual. One way in which the rules can be given wide publicity is to have all the rules covering a certain class of work printed on a card and to have this card placed at or nearby where this operation is being carried out. Rules for carmen and loaders should be tacked up at chutes; for motormen and swampers, at oil houses, sidings, skip pockets, and where these men stop for lunch. Miners on stope work should find the card nailed on timbers. Rules covering machine work, the handling of explosives, in fact all important rules, may be placed at points where the men congregate for lunch. This will be found to be a better plan than to depend entirely upon rule books. The books, however, should always be issued and the employee's receipt taken.

A classified accident records of all injuries, even the slightest, must be kept. This should be so arranged as to cover all operations in every department. This will have greater value if the report sheet used by the bosses is so arranged as to call for full details as to the occurrence of an accident. Information regarding slight, minor and no-loss-of-time accidents rarely reaches the inspector, except from the boss's reports. Injuries causing no loss of time should always be reported. These constitute about 40 per cent of all injuries, and are the ones most likely to become infected, the men believing that they are not of sufficient importance for medical attention. With our company, all hurts, no matter how slight, must be reported. Failure to report will cause the employee to be discharged.

All reports of accidents should be absolutely impartial. This is very necessary if an inspection and report is made by the inspector or safety committeemen. Particular pains must be taken to fix the responsibility and the blame placed where it belongs. Under no cir-

cumstances shall the fact that the company, or one of its officials, was at fault be ignored. If the injured, or any of his fellows, was to blame, he should be censured. In case of a fatal or serious accident, photographs should be taken of the place immediately, if possible posing a fellow-workman to show how the accident occurred. These photographs are of considerable value when used in connection with a bulletin describing the accident, as they serve to fix the occurrence and nature of the accident more firmly in the minds of the workmen.

Live, snappy, up-to-date bulletins, if simply worded and using the familiar trade terms and phrases, illustrated by photographs taken on the ground, will have considerable value in calling the workmen's attention to safety matters. What is more, the men will read and discuss them with their fellows. Bulletins to be effective should be written by one who is acquainted with local conditions. Photographs of local scenes are the only ones that have any value. If workmen who are popular with their fellows are shown in the pictures, it will cause more interest to be taken in the bulletins. The common bulletins sent out by safety organizations to all parts of the country, printed on poor paper and with cheap illustrations, if any, have just about as much effect upon the men as would an advertisement calling for recruits to the National Guard.

Writers upon safety matters are laying considerable stress on the necessity for educating the workmen to protect themselves. This is all very good as far as it goes, but it doesn't go far enough. Bosses and officials need training along these lines as well as the men and should be the first to receive it. Bosses and officials can be given this instruction at weekly and monthly meetings, where lantern slides showing local conditions, methods, practices, etc., may be thrown on the screen, illustrating the talk made by the inspector or some one in authority.

New workmen can best secure this instruction when first they go to work. They should always be placed with an old experienced employee whose business it is to see that they are fully informed as to the dangers of their new work and as to how they should proceed to protect themselves. This may cost a little more at the start but will be found to provide a more efficient workman and will be cheaper in the end than compensation payments. The tendency among up-to-date safety organizations is to secure better training for the new recruit and this method will become universal just as soon as its value is thoroughly understood.

The education of the older employees is a far more complex problem than most people suppose. The workman, quite naturally, thinks

he knows enough to care for himself, and being from Missouri, has to be shown. The one who is to do the showing must have had practical experience in the work and be one in whom the men have confidence. They also put a great deal of reliance in the recommendations for their own safety committee.

When it is possible to do so, all instruction should be given to the men when they are at work. They do not like having their leisure time taken for this purpose and will resent it if this is done frequently. If it is necessary to instruct them when they are off duty, it can best be done by giving them some form of entertainment, to which they can bring their families, and using a small portion of the time for an illustrated talk on accident prevention. A well-conducted bulletin board, with safety mottoes, rules, etc., posted near the working places, will do effective work in training the men to watch for unsafe conditions and in protecting themselves.

One thing that should be given more attention than it ordinarily receives, is that of selecting men for a particular kind of work; in other words, fitting the job to the man, not the man to the job. It is the common practice to put a man on a job; if he doesn't make good, discharge him. Yet this same man, if given a chance at something else, perhaps tried at several different kinds of work, will more than likely make good. If a man can be placed at work that he likes, he will be a more efficient, safer and better workman.

In this connection I would call attention to the indiscriminate discharge of workmen by foremen and bosses. I do not believe that any man in direct charge of workmen should have the right to discharge them, and I say this after many years spent in handling men. The practice is a relic of the dark ages and should be abolished. The trouble with the present system is that the workman holds his place subject to the whims and fancies of his boss, and if discharged, has no recourse. These days the education, training and shaping of the untrained man into an efficient, safe and reliable workman is done at a considerable cost, and the employer should not have this investment jeopardized by the sole judgment of any one man. The man in charge should have the right to lay off a man, at the same time filing a complaint against him, but his final discharge should only take place if the workman's side of the matter has been heard. The discharge of a workman should be handled through the employment office, and after the case has been passed upon by a committee.

The large corporations, realizing the value of the trained worker, are taking steps to provide a better system of disciplining the men, also to see that the men get a hearing before being discharged. It is cer-

tainly disheartening to the leaders in a safety organization to find that men who have been trained in accident prevention, mine rescue, first aid, etc., are being discharged and forced to seek work in other localities.

Accident prevention is a good business for the employee, employer and the community, and if carried to its ultimate success, will pay substantial dividends to all, but the greater returns will be received by the employee, and deservedly.

If the safety campaign is extended to cover the betterment of conditions under which the employees work and live, it will create a better feeling between both parties and will do a great deal to eliminate some of the problems that are confronting capital and labor today.

*"The greatest good can only be accomplished
where there exists a spirit of cooperation."*

PROTEST AGAINST CONTESTS

The Draeger Oxygen Apparatus Company made the following comment on the article of Mr. Wallace McKeehan, Chief Safety Inspector of the Copper Queen Consolidated Mining Company, published in the State Safety News for March:

"Your interesting article published in the State Safety News of Arizona under date of February 27th, has been called to our attention, and while you may be a little surprised that we are disposed to agree with you on the statements made therein, we want to assure you that in our estimation you have touched on a very important point in connection with Safety Work.

"If it had not been for the tendency to display breathing apparatus and resuscitation devices and to so manifestly 'play to the gallery' during the past ten years since the use of these equipments have become so general, there is no question in our minds but that more service would have been rendered and less lives lost through overconfidence and an improper knowledge of the best methods of using such equipment. Furthermore, there would not have been developed in the minds of the users at the present time the question as to whether such apparatus are of any value at all, which now exists, and exists almost entirely as a result of this form of hysteria which you have mentioned in your article.

"The unfortunate part of self-contained breathing apparatus and pulmotors is that they have such enormous possibilities in allowing

unscrupulous persons to display them simply for the purpose of the display and not for any good that they may accomplish as a result of such demonstrations. If a few more engineers of experience would take the attitude which you have taken and which has been taken by the New York fire department for example, there would be less question in the minds of the remainder as to the value in the use of such equipments, which is admittedly very great indeed, if confined to its proper field of usefulness.

"Permit us to thank you very kindly for the comments which you have made, and we trust that this thought may be carried far beyond the borders of your state, as we know that it will clear the whole atmosphere of a very important question regarding the usefulness of these safety equipments."

"One example is worth a thousand arguments." Have you learned your Safety lesson?

CLEANLINESS AND HEALTH

BY DR. W. A. HOLT, CHIEF SURGEON, OLD DOMINION

In all communities and sections of the country, including ours, the various seasons bring with them certain types of diseases and sickness. The winter months bring to us la grippe and pneumonia; the spring and summer months torture us with disturbances of the stomach and bowels, and during the late summer and in the fall we are more apt to be visited by typhoid fever.

This latter being largely a disease caused by lack of proper cleanliness, and the fall of the year being with us, I feel that the following remarks on some of the causes of typhoid fever may be appropriate. The losses from typhoid fever in Globe were particularly heavy in the year 1907. In that year there were 116 cases here and 12 deaths. When we consider that the average loss of time from work for each person having typhoid fever is 100 days, it is easy to figure that there is a big financial loss, too, particularly for those who are not fortunate enough to have access to the company hospital. All of this can be greatly improved if we will all join hands and practice cleanliness and some of the elementary principles of hygiene.

Cleanliness and hygiene mean the disposition of garbage, destruction of flies and care of foods and drinking water, etc.

The lack of sewerage is a big factor in contributing to the presence and spread of typhoid fever.

The presence of filth and organic matter in and around your houses

and yards makes an ideal soil for flies to breed upon, consequently is both uncleanly and non-hygienic.

The disposal of garbage is a very important matter. As it is conducted by our city at the present time it is a great improvement over former years, and the results have been shown by a decrease in the number of typhoid cases to the extent that we are not having to exceed ten per cent as many cases as existed ten years ago. However, there still remains ample room for further improvement, both on the part of our city and upon every one of us as individuals.

Regarding our water supply, repeated analyses have shown it to be free from typhoid, and to be considered as being entirely wholesome and healthful. It should not be allowed to stand in open vessels where there are flies, for fear of contamination.

The pesky fly, without doubt, is a very great cause in the production or transmission of many of our diseases. They may infect the food you eat, they come to your kitchen or to your dining-room table fresh from the imperfectly covered garbage can, from the manure pile, from the cuspidor, from decaying animal or vegetable matter, or from contagious sick-room, with this sort of dirt on their feet and in their bodies, and they deposit it on your food.

Flies may infect you with tuberculosis, scarlet fever, diphtheria and other infectious diseases. They have the habit of feasting on tuberculosis sputum and other discharges of those sick with these diseases, and then go direct to your food, to your drink, to the lips of your sleeping child, or, perhaps, to a small, open wound on your hands or face. When germs are deposited in milk they multiply very fast; therefore, milk should never be exposed to flies.

WHAT TO DO TO GET RID OF FLIES

Don't allow flies in your house.

Don't permit them near your food—especially milk.

Don't buy foodstuffs where flies are tolerated.

Don't eat where flies have access to the food.

Flies are the filthiest of all vermin. They are born in filth, live on filth and carry filth around with them. They are maggots before they are flies. They are known to be carriers of millions of death-dealing disease germs. They leave some of these germs wherever they alight.

Screen your windows and doors. Do it early, before fly-time, and keep screens up until the fly crop is gone.

Screen all food, especially milk.

Screen the baby's bed, and keep flies away from the baby's bottle.

Keep flies away from the sick, especially those ill with typhoid

fever, scarlet fever, diphtheria and tuberculosis. Screen the patient's bed.

Use liquid poisons, sticky fly-paper and fly traps.

Kill every fly that enters the sick-room.

Place either of these fly poisons in shallow dishes throughout the house; two teaspoonsful of formaldehyde to a pint of water, or one drachm of bicromate of potash dissolved in two ounces of water and sweetened with plenty of sugar.

ELIMINATE THE BREEDING PLACES OF FLIES

Sprinkle chloride of lime over contents of privy vaults and garbage boxes. Keep garbage receptacles tightly covered, and they should be cleaned frequently. The ground around garbage boxes and cans should be kept clean. Sprinkle chloride of lime over manure piles, old paper, old straw and all refuse of a similar nature. Manure should be moved at least once a week. Pour kerosene into drains. Don't allow decaying matter of any sort to accumulate on or near your premises.

*Never mind who was your grandfather—
what are you? Are you a Safety man?*

SUPERINTENDENT BARKDOLL ON SAFETY VS. TONNAGE

Writing in the Old Dominion Bulletin on "Safety vs. Tonnage," A. H. Barkdoll, the mine superintendent, says:

Papers and periodicals are constantly calling our attention to the benefits that can be derived from the proper application of the Safety First movement. Such articles usually lay stress on the diminution of suffering and loss of life that can be effected by proper safety methods on the part of the employer and by the elimination of carelessness on the part of the workmen. We should realize, too, the monetary saving that must result to both by the reduction of accidents. Today most mining enterprises have inaugurated safety departments and consider it one of the most important units of their organization, both from a humanitarian and financial point of view.

In the operation of a mine, accidents to machinery and men alike cause delays, reduce production and decrease efficiency. Every accident to a workman interrupts the progress of the work in hand, for often a new man has to be trained before he can do the same work efficiently. Notwithstanding, some employees, if reprimanded for working under dangerous conditions, argue that the boss wants ton-

nage rather than safety, and if he takes time to make his working place safe he will not get out sufficient tonnage to satisfy the boss. Bosses for the most part are selected from the ranks for the following qualifications: Efficiency and knowledge of their work; ability to handle workmen justly, and possession of a reasonable amount of common sense and good judgment.

Foremen and bosses agree unanimously that in order to secure good work from each and every man and to insure the best results, that all working places must be made as safe as possible. It stands to reason that a man working in an unsafe place where he is afraid of being hurt is not going to do his best work. Laboring under adverse conditions in any vocation is comparable to one's trying to make speed upon an unknown road in darkness. If a piece of machinery designed to perform certain work fails through mechanical defects or faulty construction it is a source of danger to all and is usually laid aside for a more efficient piece of machinery. Similarly, to secure the best results in the safety movement any employee who is habitually careless and not capable of making his working place safe, thereby endangering his own safety and that of his fellow workmen, should, like the defective machine, be laid aside and a better man secured to take his place. He is not called upon to take unnecessary chances to carry out his work, and if he does, he is also taking big chances on holding his job. In contrast to the careless man there is always to be found the much larger class of ambitious young men, steady family man, and the respected and appreciated old employee, whose efforts to cooperate with his employer in this safety movement are of the greatest possible assistance.

*Let's help the new man on the job—we were
once new on the job ourselves.*

TO AVOID COLDS

1. Avoid hot rooms.
 2. Avoid excessive fatigue.
 3. Avoid over eating.
 4. Avoid people with colds.
- To avoid complications of colds:
1. Do not blow the nose excessively hard.
 2. Keep elimination very active.
 3. Keep comfortably warm at all times.

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NATURALIZATION

BY J. M. LANE

An alien must first take out what are commonly known as his "first papers" which may be applied for immediately the alien arrives in this country. This declaration may be made before the clerk of any United States circuit or district court, in the district in which he resides. The applicant must state that it is his bona fide intention to become a citizen and that he renounces forever fidelity to any foreign power to which he may be subject.

In his declaration the alien must give his age, occupation, personal description, place of birth, last foreign residence, date of arrival, the name of the vessel on which he entered the country and his present residence. For this declaration the fee is \$1.00.

In not less than two years or more than seven years after his "first papers" have been taken out, the applicant must file in duplicate, a petition in his own hand writing, in which he must establish the fact that he has resided in the United States continuously for a period of five years at least, and within the state or territory where the court at that time is being held for at least one year. Should the petitioner have made previously a petition for citizenship to any court he must state in detail reasons for denial of same.

The petition must be verified by at least two credible witnesses, who are citizens, and who shall state in their affidavits that they have personally known the applicant to be a resident of the United States for a period of five years continuously and of the state, territory or district in which the application is made for a period of at least one year immediately preceding the filing of the petition.

When the court is satisfied that the petitioner has complied in all respects with the law governing naturalization, the court issues the final order which entitles the petitioner to be admitted as a citizen of the United States.

If any alien who has received a certificate of citizenship shall return to his native country or take up a permanent residence in any other foreign country, his certificate may be cancelled.

The fee for making and filing the petition is \$2.00 and a similar

amount must also be paid when the final order is entered and the certificate issued. The petitioner must also deposit with the clerk of the court a sum of money sufficient to pay for any necessary witnesses who may be called in behalf of the applicant.

Naturalization is limited to white persons and those of the African race, and no alien who is a native citizen nor a subject of any country with which the United States may be at war at the time of his application can be admitted into citizenship. The penalty for procuring illegal naturalization is a fine of not more than \$5,000, imprisonment of not more than five years, or both.—LEFAX.

*The defective citizen of today is ofttimes
the unhealthy child of yesterday.*

THIRTY FIRST AID ISMS

COMPILED BY DR. W. N. LIPSCOMB,
Field Representative, American Red Cross.

1. The best way to treat any injury is to prevent it.
2. First aid work merely means applied common-sense based on a little extra knowledge.
3. The fate of an injured man depends upon the individual into whose hands he first falls.
4. The man afraid to apply first aid, knowing how, is a coward; the man who calls it "hot air" is dangerously ignorant; the man who does the right things at the right time is the real man.
5. The blind rush to a hospital without first attempting relief is insanity—patients have died on the way from loss of blood and shock.
6. Seventy-eight out of every one hundred cases of infection or "blood-poisoning" begin in the hand—remember this when you get an injury there.
7. Do not drill a black finger-nail with a knife—it may cause a whitlow or bone-felon.
8. The little wounds are dangerous—often more so than the large ones—give them immediate and careful attention.
9. Do not "wash out" any wound with water—it merely drives the "germs" deeper in.
10. A man spent 368 days in the hospital in the state of Washington because he let another man pick a splinter out of his hand with a pocket knife—will you be the next to contract such a case of general "blood-poisoning?"

11. If you have nothing surgically clean to put on a wound, leave it exposed to the open air—it is safer.

12. Keep your hands, clothes and handkerchiefs out of a wound—it is dangerous to so tamper with it.

13. Keep cotton out of wounds and burns—do not force a surgeon to “pick the goose alive.”

14. A man's eye is a delicate piece of machinery—keep sharp tools out and avoid the dirty ones.

15. In treating fractures (broken bones) anywhere, first cut away clothing—there is often a wound present.

16. Many a simple fracture has become compound from hasty or rough handling; a man who has a fracture is likely to have an open wound through the protruding of sharp end of bone if mis-handled.

17. Properly splint or immobilize a patient's limb when broken, before moving him. It may save money and bad results.

18. Never move a man with a broken leg before you see that it is placed in well padded and comfortable splints.

19. If in doubt whether a break exists anywhere, fix as such—this treatment cannot do harm; it may help greatly.

20. Be careful about dislocations. If not able to reduce, bandage in most comfortable position for patient.

21. Prevent a man from walking on a sprained ankle—one or more bones in the foot may be broken.

22. Elevating injured arms and legs in case of accident means increased comfort for the patient, especially in event of crushed injuries.

23. The coat makes a good sling—hold injured arm horizontally across chest—fold coat over arm and secure the corner near the neck with a pin or nail. Also pin behind to steady arm against shoulder.

24. In making an emergency stretcher, first try it out with an uninjured patient—it may prevent serious consequences.

25. Walk slowly with patient feet foremost on a stretcher; why needlessly shake him up?

26. In applying a tourniquet or “twister” be sure to loosen gently about every twenty minutes—this is an absolute rule for comfort and safety.

27. The tourniquet is a “good servant, but a bad master”—be sure that you apply it correctly, and use something broad, not wire or rope.

28. Keep an injured man's head low, loosen clothing, look for external injuries, keep him warm, but yourself cool, handle as little and as gently as possible.

29. Lowering a patient's head in case of fainting is the first and main essential in treatment.

30. To deal with an epileptic fit—prevent person from falling, place a stick or handkerchief between teeth, then observe "watchful waiting."

Approved by Major Robt. U. Patterson, Medical Corps, U. S. Army in charge Bureau of Medical Service, American Red Cross, 1624 H Street N. W., Washington, D. C.

The New Jerusalem, the model city is prophesied by a very old book. The road to it is through "clean living." We are off on a long hike.

MINING AND LIQUOR

In his annual report upon the mining industry of Idaho, the state inspector of mines, Robert N. Bell, calls attention to a very marked reduction in the number of fatal accidents in the mines—a condition which he deems the more significant in view of the larger demand for labor, the shortage of experienced men and the greater number of green hands, unfamiliar with the hazards of the business.

Among the favorable causes, Mr. Bell mentions prohibition of the liquor industry as a very important factor in the reduction of the number of accidents. He considers that, if the law is enforced, it will continue to maintain good results in the matter of safety to mine employees.

It is generally recognized that the industrial managements of the United States are largely responsible for the growth of prohibition sentiment; a greater measure of safety and efficiency is sought by this means.

But it is so often noted that, before the era of prohibition in the west, state laws existed to exclude the use of liquor in and about mining plants. Where such statutes have not been adopted, mine managements have themselves enforced regulations of their own bearing upon the same subject.

Certainly there is no occupation in which soberness is held to be so essential to the safety of the working forces. The employees of mines are as much a party to the adverse sentiment as the managements; no miner deliberately chooses to work beside a drunken man, unless he is himself intoxicated.

The extension of prohibition to the entire population in several

western states has not added much to the protection of large mining properties and their employees, because these mines had already set up their own rules.

Uniform mining codes, designed by committees for the benefit of the mining states, have always touched upon this subject. What is true of the large mining plants has frequently been true of other industrial establishments, including those of the east, where state-wide prohibition finds greater obstacles.

Viewing the matter strictly in its historical aspects, the advance of the prohibition principle seems to be an expression of the triumph of industrialism over individualism.

It is the careless, thoughtless and indifferent men who contribute to the support of the undertaker.

HEALTH INSURANCE FAVORED

The attitude of the best physicians in Massachusetts, according to Governor McCall, appear to be favorable to the governor's health insurance recommendation contained in his inaugural message. The governor has been highly pleased with the response from the general public to the health insurance recommendation.—BOSTON (MASS.) TRANSCRIPT.

The man who is too proud to show himself in his shirt and dig and hoe, rake and plant and push the mower, is hopeless.

A LITTLE HARSH

The victim of an accident glanced thoughtfully at the caller's card. "I guess you're what they call an ambulance chaser, ain't you?" demanded the injured one.

"That's rather a hard name, old man," replied the lawyer blandly. "Why not call me a settlement worker?"

"An optimist is one who makes lemonade out of the 'lemons' handed to him."

"Labor and capital are naturally partners, not enemies.

"The personal relation in industry, entered into in the right spirit, gives the greatest promise of bridging the yawning chasm which has opened up between employer and employee."—From recent address by JOHN D. ROCKEFELLER, JR.

MEN WHO GOT AHEAD—AND WHY**By J. OGDEN ARMOUR***From The American Magazine, March, 1917.*

J. Ogden Armour's companies do a business of \$500,000,000 a year, and Mr. Armour employs 40,000 men.

One of the truest axioms I know is the business saying that "the best trained man is the self-trained man." It is my belief that no man developed by a formula in a business organization can ever reach the power of one who is put on his own responsibility, knowing that his advancement depends on his own brains, foresight and application.

By this I do not mean that a business leader should let his men go along blindly. He must always give something of himself. But in any office organization the man who has never had to stand squarely on his own feet is never in a position to march ahead.

Almost every executive in our company has risen from the ranks.

We try to run our business so that everyone, from the latest office boy all the way up the line, knows the business of the man just ahead of him.

Several years ago I had occasion one forenoon to send a note to a superintendent in our office building. My own boy was away on another errand and a new messenger answered the call. The note was never delivered.

"How are boys hired here?" I asked.

"Oh, we take almost any boy who comes along," I was told. "Some of them are employed because their fathers work here."

This statement set me thinking, and it resulted in the development of the system by which the hiring of boys has become a very painstaking part of our business.

Cleanliness, good manners, good physique, mental agility, and good habits are primary requisites.

"Why do you want to work here?" is a question we always ask. If a boy shows that he merely wants to make a little money, there is no place for him; if he has a vision of working up in the business—in short, if he is ambitious—it is a strong point in his favor. All boys who enter our service are examined by physicians and given opportunities for physical training. Those who show an aptitude for office work are placed accordingly, while those who seem to prefer manual to mental labor are steered out into the plants.

This general system has one drawback. The ranks of our office boys and stenographers are being continually disrupted by the gradua-

tion of these employees into positions of higher responsibility. "Once a bookkeeper always a bookkeeper" is not true here.

WHERE OUR SUPERINTENDENTS COME FROM

Twenty-five years ago a young man came to Chicago from a little town in Kansas. After looking several days for a job, and finding none, he drifted out to the stockyards and was put to work as a laborer in the butterine department at \$1.75 a day.

"I was worked so hard," he said afterward, "that I made up my mind to look for another job; but I was too busy during the day and too infernally tired at night."

So the young Kansan stayed on and kept the pace. As soon as he really got his bearings he was setting a new pace, always working a little harder, thinking a little more quickly, than the man beside him. Promotion came, as it is bound to come to men of this type.

Today John O'Hern, the former Kansas boy, is general superintendent of all our plants.

Take the case of Pierce. Many years ago he came to us, a timekeeper. Eight or ten other men were doing the same kind of work, and Pierce might have quietly become one of them and never been heard from. But he was not satisfied with being merely a timekeeper, he wanted to know the why and wherefore of every angle of the business with which he came into contact. While he was in the process of informing himself he discovered that the pay roll had been heavily padded for years—that the names of men not in the employ of the company were carried on it. Any of the other timekeepers might have made the same discovery, but they fumbled the chance. By proving himself the possessor of a direct, projective mind he was given charge of construction work. Later he became superintendent of the beef end of the business, and when plans were made for building the South American plant it was Pierce whom we picked to do the job.

Perhaps the most interesting story of all is MacDowell's, for it shows how a man can win success by always watching for an opening and jumping into it. MacDowell had picked up stenography as a diversion and had shown some little ability in making sketches.

In those days my father used to go to Europe every summer, and each year he would have a private telegraph code made up for his used by his secretary. This year the secretary turned the job over to MacDowell.

Instead of getting up an ordinary code on a few sheets of paper, MacDowell designed a little booklet, bound it in seal, and printed

the code in illuminated letters. The next day the secretary handed in the code.

"You didn't do this," said my father.

"N-n-o-o sir," stammered the secretary.

"Who did? * * Send him to me."

"Young man,"—as MacDowell came into the office—"how did you happen to get my code up in this shape?"

"I thought it would be handier for you, sir."

"When did you do the work?"

"At home, nights."

"H-m-m! Glad to know it."

A few days later MacDowell was given a desk in the front office, and not long afterward he was appointed to succeed the secretary.

MacDowell's next opportunity came when my brother decided to build a barn. Knowing that the young secretary had some sketching ability, he asked him to draw up a rough plan. The matter was not of tremendous importance, but MacDowell had the habit of giving his best effort to seemingly unimportant things. He went to some architect friends, found out the laws of stress and strain, and got their advice and help about the project. The plan MacDowell turned in was so splendidly executed that he was given a chance at more construction work around the yard. Immediately he began attending night school, studying higher mathematics and draftsmanship, and applying everything he learned to the problems at hand. In these days he was working from four-thirty in the morning until nearly eleven at night. Finally he got so worn out from the strain that my father sent him out West for a vacation.

But MacDowell belonged to the type of men who never overlook opportunity. In Arizona he discovered that the butter on sale was very inferior, and that butterine and oleomargarine were practically unknown. He sent on for a cargo of fifty-pound pails of these products, and had them handed out among the merchants. He started up a good trade, found other openings, and before he came back to Chicago he had sold twelve carloads of packing house products.

On his return he was put in charge of the butterine exhibit at the Chicago World's Fair. Here he saw some exhibits of German potash. Investigation showed him that our company was in a strategic position to make fertilizers, and he convinced my father of the wisdom of venturing in the new line. He was put in charge of fertilizer manufacturing, and now he is president of the Armour Fertilizer Works, one of the most important branches of our business.

To me, every boy, every young man, who enters our employ is an

investment. If he fails to grow, to advance, he is a bad investment, and we are the losers. If he makes a mistake, instead of criticizing him, we try to find out what led him to make the mistake, and aid him in avoiding its repetition.

"If a man finds fault with a boy without explaining the cause to him, I won't fire the boy, I'll fire the man," one of our department heads said the other day. "We have not a square inch of space in this organization for the man who criticizes a subordinate without telling how to do the thing better."

A boy in the office of this same executive was once discharged by the office manager for letting his youthful spirits bubble over into a breach of discipline.

"Did you talk with the boy and try to find out what prompted his action?" the executive asked.

"No!" said the manager curtly. "He was too fresh."

"Really? Do you know I was just thinking that probably I would have done the same thing when I was his age. * * * Send him in to me."

When the boy had drawn up a chair, the executive leaned forward kindly.

"I'm sorry to hear what you've done, Harry," he said. "It wouldn't have mattered quite so much, you know, if you hadn't been my own personal boy. When you do a thing like this, and the other boys find it out, they'll say among themselves: Well, if the boss's boy can do that, I guess we can."

All the resentment from his discharge slipped from the youngster, and he burst out crying.

"If you'll take me back," he promised stoutly, "I'll never do it again as long as I live!"

He was taken back, and today he is holding down an important position in an able fashion. And the executive has ventured the belief that when he gives up his job the one-time office boy will sit in his chair.

From my own experience with boys in this organization for more than twenty years, I would say that "ninety-five per cent of all boys are what you help them to make themselves."

In choosing between experience without education and education without experience, I select the former. This is the reason we have so few college men in our organization.

All our department managers, having come up from the ranks themselves, naturally are interested in giving other men opportunities for self-development. The other day one of our executives came

across a middle-aged fellow of unpromising appearance who was checking the loading of cars for the butter and egg department.

"How much are you paying this man?" he inquired of the foreman of this department.

"He is getting twenty cents an hour."

"Give him another job. This is the first stage in this particular operation that requires thinking. Anyone can lug boxes, but it takes a little headwork to keep tally of them. Put a young man here. Change the wages from twenty cents an hour to fifty dollars a month, so that the fellow who holds the job won't think of himself as a day laborer. Let him feel he is a regular monthly paid member of our organization—and you have a potential executive in the making."

Whenever men attract your attention so that you wish to promote them, seven times out of ten they will grow up to their job, even if they were not big enough to fill it when they were appointed.

A man who has developed personality, enthusiasm, loyalty and organization sense will pick up the necessary information in any position in which he is placed.

Once my father needed a man to take charge of an important branch house, and he picked one of his clerks. The clerk was an ambitious, trustworthy young chap, and an indefatigable worker, but he knew literally nothing about the branch house end of the business. To supplement this deficiency, a man who had a practical knowledge of beef was sent along with him.

After a few months the trained assistant grew restless. He felt that he was swinging the practical end of the branch house affairs and that he was entitled to the glory. So he made the excuse of taking a local butcher to Chicago to persuade him to buy from us, in order that he himself might come on to the main office. The next day he returned to the branch house and tendered his resignation.

"What does this mean?" asked the manager.

"I lied to you about taking that butcher to Chicago, the man stammered; I really went in to ask the Old Man for your job. The minute I explained my mission he wheeled around in his chair and yelled, 'Take the next train back and hand in your resignation, and don't let me ever see you again.'"

Just how my father's faith in putting responsibility on young shoulders was justified is shown by the fact that the inexperienced branch house manager is today one of the most important officers of our organization.

Beyond the great advantage to a corporation in having executives trained up from its own ranks, there is the tremendous lift in the

working force itself. Nothing will make more for loyalty and energy in an organization than the knowledge that employees are being promoted continually from the bottom. It gives men ambition, it gives them pride; and pride and ambition, as my father used to say, will keep a man working at top speed when money is merely a byproduct.

Many men of average ability are kept from greater accomplishment through reluctance to put in a good assistant who may show up more brilliant than they. Another common failing among executives is a disposition to do relatively minor duties, because it happens that they can do them better than anyone else in their organization. It is better for a man to accept efficiency ten or fifteen per cent below his own in such matters, and save his own time and ability for the really big things. These are two of the evils which we try to avoid here.

LEARNED FROM THEATRICAL PRODUCERS

Few plays are ever put on the boards without an understudy for every important part. And yet some business organizations, either as a whole or in departments, are run on the "one man plan." When this man drops out the whole structure totters.

We try to run things here so that every man knows the duties of the man just ahead of him. We encourage men to be inquisitive, and we satisfy their curiosity. Sometimes, if that man ahead is not looking sharp, he finds himself shoved out automatically by a pushing chap behind him. We try to guard against any such thing as an automatic foreclosure of opportunity to anyone.

Any man who is master of one thing is a success. Given a group of men, each master of one thing, and you have a successful organization. Such organizations are seldom a galaxy of scintillant starts. It is team work that counts. In baseball the star second baseman who fails to cover first when he should, is likely to draw a fine; if he makes that negligence a habit, he probably will be released. Champion ball clubs—those which share in world series purses—are usually made up of fair, reliable, strong-hearted players who work together like a machine.

The trouble with many brilliant men is that they "won't stay hitched," as my father used to say. We don't want fellows who have to play a solo. We put a man on his own responsibility as far as his own job is concerned; we encourage him to push on, but he must have organization sense and loyalty, or even brilliancy may be a handicap. A business organization should be as well coordinated as a symphony orchestra.

I shall never forget one lesson in loyalty and team work that I

learned from my father many years ago. It came in the form of a letter to my brother and me, and although it referred directly to our business, its principles are broad enough to apply to any business. This is the letter:

"My Dear Ogden and Phil:

In the course of a conversation with Mr. Earling, Supt. of the C. M. & St. Paul Ry., he related a little incident to illustrate why railroads don't succeed better.

He said that while he was in Minneapolis last week he stepped into a little cigar store near the depot and bought a couple of cigars. As he was lighting one he asked the man whether he was doing a good business. He said, yes, he had all the Milwaukee & St. Paul Railroad trade, and that was a very large volume indeed; in fact, it was practically all the business he had.

"Then Earling asked him where he bought his cigars, and he replied, 'In New York.'

"He then asked how he shipped them, and he answered, 'Via the Burlington Road.'

"'You get all your patronage from the St. Paul and yet you give all your patronage to the Burlington, a road that you never had a bit of trade from.'

"'Oh, well,' said the cigar man, 'I never thought anything about that. *I have never been asked by any of the St. Paul people to ship them via their road.*'"

"Mr. Earling said that fundamental principle was the same all through the railroad business—the men about the road did simply what they were told to do and what they thought was their duty, but they were not inventive in their heads nor tried to help the railroad. They never looked so far ahead as to see that by boosting the railroad for which they worked they also helped themselves.

"Of all the great number of employees who supported that tobacco store, not one had ever asked the cigar man to send his business over the St. Paul railroad. Of course, they were not the commercial men, exactly, of the road, but they thought nothing concerned them except their special duties.

"Consequently, that was why railroads in a great measure fell short of giving the results to the stockholders that they might give, and, naturally, that meant they did not pay the men what they might pay them.

"If every man about Armour & Company would pay a little attention to supporting and helping the house, it would go a very long way toward the success of the house: and no one connected with Ar-

mour & Company could go out of his way and show that he took an interest in their success but what the house would soon find it out.

"It would be a very simple matter for any of our boys, on going into a store, if they didn't see our goods, to ask why, and if they could not find out, it would be easy to report it to the commercial part of the house.

"Sincerely yours,

"PHILIP D. ARMOUR."

Successful men show man contrasting characteristics—but the one quality which they never lack is thoroughness. Business is full of men who would be at the top if they had only learned to think their thoughts out to a conclusion. They know that 2 and 2 make 4, but they never stop to think 4 *what*.

Many of these half-way folks get by, but they never get far. There is always a premium in business on the man who does his work painstakingly, with completeness and finality; he is the man who will be trusted with more and more responsibility, up to the limit of his capacity. The man who informs himself adequately about his firm, its methods, its policies and its product, who does his work so well that no one need follow him up to patch the ragged edges, is on the safest, surest and shortest road to achievement.

I remember my father called one of his men into his office one day and asked him what figure the receipt of hogs had reached the day before in Kansas City.

"I don't know *exactly*," replied the man; "but I can tell you *about* what figures were."

"Well, what were the Omaha figures?" went on my father.

"I know *about* what they were," was the reply.

My father wheeled around in his chair.

"Young man, get me those figures exact," he ordered. "Your guesses don't interest me in the least. If there's any guessing to be done around here, I'm a pretty good guesser myself."

In our business—and I take it that this is true of most business organizations—the man who succeeds is the man who "brings back the answer," not the approximate, but the right answer.

Sentiment in business was never more alive than it is today. Any able employer of labor knows that kindness and fairness build the cornerstone to a man's best effort. From a purely commercial standpoint, discarding all other reasons, they are the soundest investments in the world. You can buy a man's work, but you cannot buy his loyalty. That can be gained only by treating him fairly. I have declared repeatedly that any success which has come to me has been

due almost entirely to the loyalty of my men and their eagerness to please me. I consider this sentiment of more value in dollars and cents than the entire financial investment in our business.

I do not want my men to work because they fear me, or because they are afraid of losing their jobs. I want them to work because they want to work, and because they would rather work here than any other place in the world. A man is no good to me unless he is necessary to Armour & Company, and we are necessary to him.

I make it a rule that my door shall always be open to my men, and any employees, down to the humblest day laborer, may feel free at any time to bring his troubles to me directly. My job would not be worth while under any other conditions.

In the last analysis, a business and an individual have much the same characteristics; they make friends and enemies in exactly the same ways, and nothing pays either quite so well as to be fair.

*Don't overload your stomach with water;
drink slowly and in small quantities. Don't
use ice cold drinks.*

RAY CON CLUB'S SMOKER PROVES TREAT FOR MEN

The annual smoker of the Ray Con Club of Ray was held recently and from reports trickling into Tucson it was one of the biggest affairs of its kind ever held in the state. There was a large crowd of members and their friends present, the whole affair being under the supervision of L. A. Blackner, assisted by George G. Wald. Everything was original, from the boxing bouts staged at the beginning of the festivities to the newly made motion picture at the end.

The Ray Military Silver Cornet Band, under the direction of Prof. Shields, was in attendance, and rendered new and popular music during the evening which earned plenty of applause from all present. Under the direction of the new leader, the Ray Con band promises to be up with the "big ones" as a musical organization.

After several selections by the band, the program of events and entertainments was started by a very clever exhibition of catch-as-catch-can wrestling, participated in by Morton Poiser and Gus Larson, both showing fine form and exhibiting an extensive knowledge of the wrestling game. Young Moxie was somewhat handicapped by the fact his opponent had the advantage of about twenty pounds in weight, or a different result might have been reached, but as it was Larson won two falls and the bout, in 9 and 4 minutes, respectively.

Next on the program appeared "Some Canadian," Ray Lacey, a monologist, who told several stories earning him round after round of tremendous applause.

At this stage of the show appeared two young exponents of the manly art of self-defense, Young Graham and Otto Boedecker, who, after being introduced by the referee, Harold (Kid) Carpenter, proceeded to mix things right from the gong. Young Graham had the advantage of height and reach, but what his opponent lacked in these attributes, he made up in agility, science and "cover-up-ness," and was thus enabled to stand off his taller and heavier assailant for two very interesting rounds.

Next a very remarkable mind reading act was staged by Eddie Baker and Fred O'Brien, which was a scream from start to finish. The questions asked and the answers given would have put Eva Fay to shame, and if Mr. Baker desires to retain his position as umpire of the Ray Con Ball League, he should keep out of the way of E. F. Albee of the Keith vaudeville circuit, who would snap up his mind reading act pronto.

The grand finale of the entertainment was the screening of Col. C. P. Harter's photoplay entitled "An Indian Princess Sacrifice," one thousand feet of which was made at Walpi, on the Moqui Indian reservation in northern Arizona, showing the snake dance of the Hopi Indians, which takes place every year in July at their village. Col. Harter, with the aid of a half-blood Indian girl, Princess Indita, wrote a scenario, directed and produced two thousand feet of film, which being added to the original Hopi snake dance, makes three excellent reels of Indian photo-drama. This truly wonderful production was shown at the smoker as complimentary to the Ray Con Club by Col. Harter, and was screened by Harmon Lewis with a Powers' 6-A Projectoscope. The picture was enthusiastically received by the audience, and the producer was obliged to respond to the applause by a short speech.

After another selection by the band and a few appropriate remarks by the president, refreshments were served, thus ending one of the most entertaining and satisfactory smokers of the Ray Con Club.

Among those present were L. S. Cates, general manager; E. W. Cates, W. S. Boyd, superintendent of mines, and R. A. Cook, chief clerk of the Ray Consolidated Copper Company.

*Yesterday is gone—forget it;
Tomorrow is yet to come—plan for it;
Today is here—use it.*

A. S. & R. WELFARE WORK

"I am especially pleased to be able to announce that a fund of \$500,000 has been set aside for the welfare work in all of our plants, and while much has been done in the Leadville plant, we expect to add to this materially," Mr. Guggenheim said. "There will be shower-baths, club-rooms with pool and billiard-tables, and other accessories for improving the condition of the men. When necessary we will not only look after the welfare of our employees while they are at the plant, but will take an interest in those vital questions of home life and living conditions. Trained nurses will be provided when necessary, and other steps taken in looking after the families of our employees. We believe in dividing our profits with our men. Irrespective of this, wages have been increased in all our plants and every effort has been made to look after the best interests of our employees. It is the purpose of the company to increase the facilities for taking care of the increased production of ore which is being stimulated by the growing demand for metals. It is our aim to co-operate with the miners whenever additional extensions to our plants are required, for we fully recognize that their interests and our interests are identical. Of course, in times like the present, it is difficult to procure the necessary equipment for immediate delivery, but we are making special efforts in that direction. I find that the mines here are showing increased activity and that the town is more than holding its own. Leadville may well pride itself on being one of the premier metal-producers of the West, and our faith in its future is indicated by the fact that we are actively engaged in making whatever additions and improvements the conditions at our plant call for."

Experience is what everybody call his mistakes.

SWAT THE PESKY FLY AND SAVE TROUBLE

1. Where do young flies live? In filth and manure.
2. Where do flies first dirty their mouths and feet? In every kind of filth imaginable.
3. Is anything too dirty or bad smelling for flies to eat? NO.
4. Where does the fly go when it flies from the vault, the manure pile or the spittoon? (a) It may wipe its feet upon the clean lips of your sleeping baby; (b) It may carry germs into the open wound

on your hand; (c) It may track over the butter, the meat, or take a bath in the milk.

5. Is the fly merely a nuisance? No. It is very dangerous.

6. Why is the fly considered dangerous? It is man's worst pest. It is more dangerous than the rattlesnake or tarantula. It carries deadly infectious diseases.

7. What diseases does the fly carry? It carries typhoid fever, tuberculosis, and various intestinal diseases.

8. How does the fly carry diseases germs? The germs stick to its legs, mouth-parts, hairs, wings and feelers.

9. What is the correct name of this human pest? The TY-

10. Has it ever caused anyone's death? It killed more American soldiers in the Spanish-American war than all the weapons of the Spaniards. It has killed thousands of soldiers during the present European war.

11. Why is typhoid fever so prevalent during the summer and fall? Because flies are more numerous during those seasons.

12. Why is typhoid fever common in one community and not in another? Largely because the common house-fly is abundant in one locality and is controlled in the other.

13. Where are flies most abundant? Where there is most filth.

14. How shall we kill the fly? (a) Destroy all filth about the house and yard; (b) Put lime into the vaults and over the manure; (c) Trap all flies before they enter your home by using wire fly-traps; (d) kill all flies, large or small, with a "swatter;" (e) Use sticky fly-paper or fly poisons around the house or store; (f) Pour a borax solution over manure, filth or other places where the fly may rear its young.

It's by perspiration, not inspiration that inventions are made.—Edison.

SAFETY FIRST

Lock and test your safety lamp;
Examine well for fire damp;
Be sure your shots you do well tamp—
"Safety First."

Look out for electric juice,
And see the timbers are not loose,
And beware the mule's caboose—
"Safety First."

Never let your fancies roam;
Never be "nobody home;"
Keep a level-headed dome—
"Safety First."

There are no angels watching you,
Good miners know that it is true
That God helps those who think and do—
"Safety First."

Don't indulge in any booze,
And keep the car wheels off your shoes,
And be liberal with the fuse—
"Safety First."

Be sure the treacherous roof you test;
Be careful where you sit to rest,
At rib or prop is always best—
"Safety First."

Always kick about the dust,
For it can be wet, and must,
Or some day the mine will "bust"—
"Safety First."

If there's gas it's up to you;
Don't light up and smoke a few,
Or the mine may light up too—
"Safety First."

Study up that first-aid fad,
If you don't you'll wish you had,
Some day you will need it bad—
"Safety First."

—K. H. CHISHOLM.



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